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Final Report

Quantification of Occupant Response and Injury From Impact

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16. Abstract
This report describes a number of side impact tests conducted using human cadaveric subjects. The tests used a sled to investigate whole body lateral impact response in a variety of conditions including both padded and unpadded walls. Information describing test procedures used dynamic responses measured, and injuries observed is also included.

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Introduction

Within the total automotive crash problem, side impacts have been shown to produce a large portion of both serious and fatal injuries. These injuries are produced as a result of the rapid changes in velocity an automobile occupant's body experiences during a crash. Any improvement to the side impact problem will be brought about by means that will ultimately modify the occupant's rapid body motions to such a degree that they will no longer produce injuries of serious consequences.

To achieve this goal, accurate knowledge of both the body's motion and resulting injuries under a variety of impact conditions is needed.

Possession of this knowledge will allow development of accurate anthropomorphic test devices and injury criteria which can be used to create effective injury coutermeasures in vehicles.

Scope

The scope of the project was to investigate "Responses and injuries of the human body in lateral collisions".

Test Subjects

Test subjects were male and female human cadavers in the age range of 17 up to 79 years (Tab. 3) and the HSRI SID.

Test Method

The tests were performed on the decelerator sled of the Institute for Forensic Medicine of the University of Heidelberg (Kallieris 1974). To achieve a lateral impact test condition where the specimen approaches the impacting wall laterally at a predetermined velocity, the specimen is initially placed parallel to and approximately 2 to 3 feet from the impacting wall which is at 90° to the direction of travel of the sled (Fig. 1). The test sled is then gradually brought up to test speed with the offset distance between the cadaver and wall maintained. The sled then rapidly decelerated to zero velocity in a distance less than the offset

distance. Since the specimen is supported on low friction surfaces, it continues to translate laterally over the ground in its seated position, at the speed of sled prior to deceleration, toward the impact wall and impacts the now stationary wall at that speed. The conditions of the test are then solely determined by the test speed of the sled before deceleration and the compliance and geometric characteristics of the impacted wall.

Test Conditions

The investigated test series are considered according to test subejct, collision velocity and impact area specification. The lateral impacts were conducted with velocities of 24 km/h, 32 km/h and 40 km/h. The left side of the test subject impacted

a) into a rigid wall (Fig. 2)
b) into a wall with HNCB pad (Fig. 3)
c) into a wall with APR pad (Fig. 4)
d) into a wall with 2", 6", 12" Ensolite pad (Fig. 5)
e) into a Volvo door (Fig. 6)

The lateral impacts into a Volvo door have been conducted according to agreement between NHTSA and AB Volvo. Also according to agreement between NHTSA and AB Volvo 5 frontal collisions with belt-protected human cadavers have been conducted. The tests have been also performed on the deceleration sled. The chosen pulse is similar to the pulse from a Volvo P 140 impacting a fixed barrier in 30 mph. This pulse was chosen to enable comparisons to be made with earlier work.

A Volvo 244 front seat and a three-point retractor belt have been mounted on the sled. The longitudinal and height adjustment of the seat have been positioned in such a way that the feet of the cadaver were resting on the floor pan and the knee-proximal femur is just barely resting on the seat cushion (Fig. 7).

A review of the conducted test series can be seen in Table 1 and Table 2.

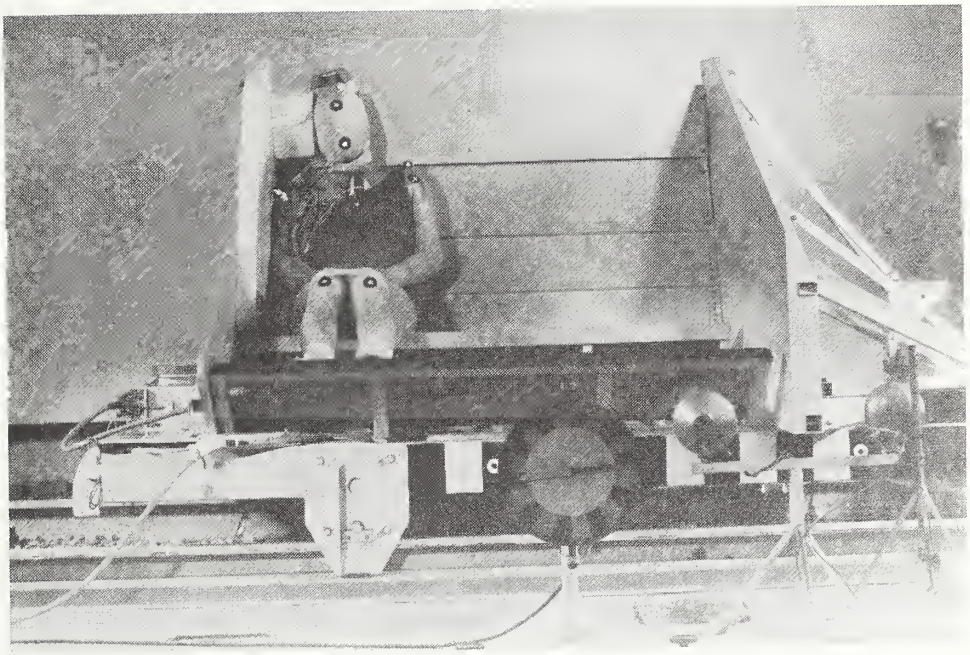

Fig. 1 Impact sled configuration for side impact tests (rigid wall without shoulder and pelvis force measurement)

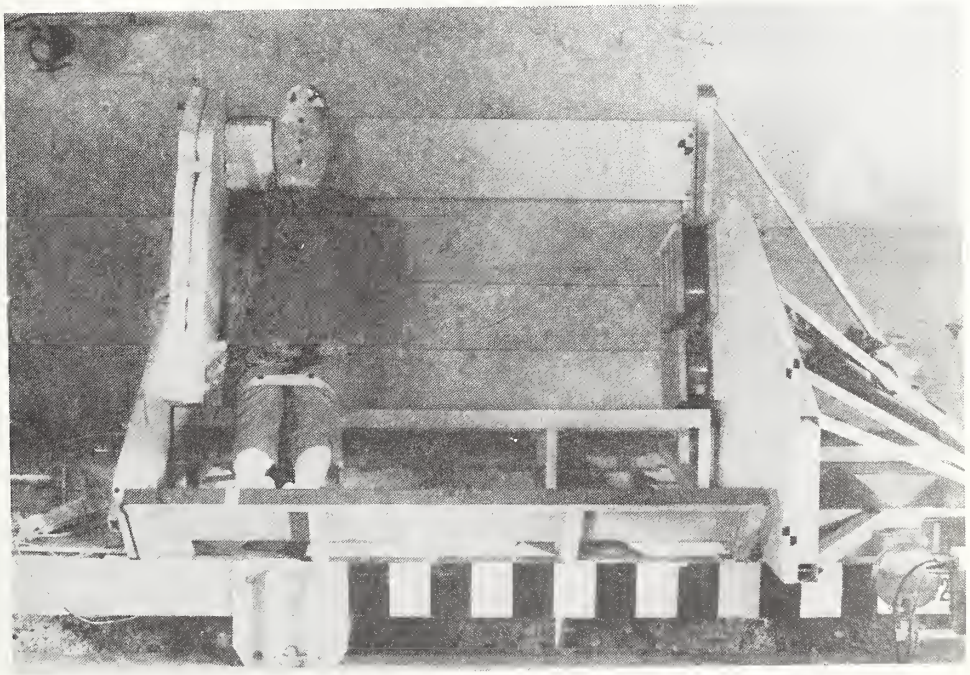

Fig. 2 Impact sled configuration for side impact tests (rigid wall with shoulder and pelvis force measurement)

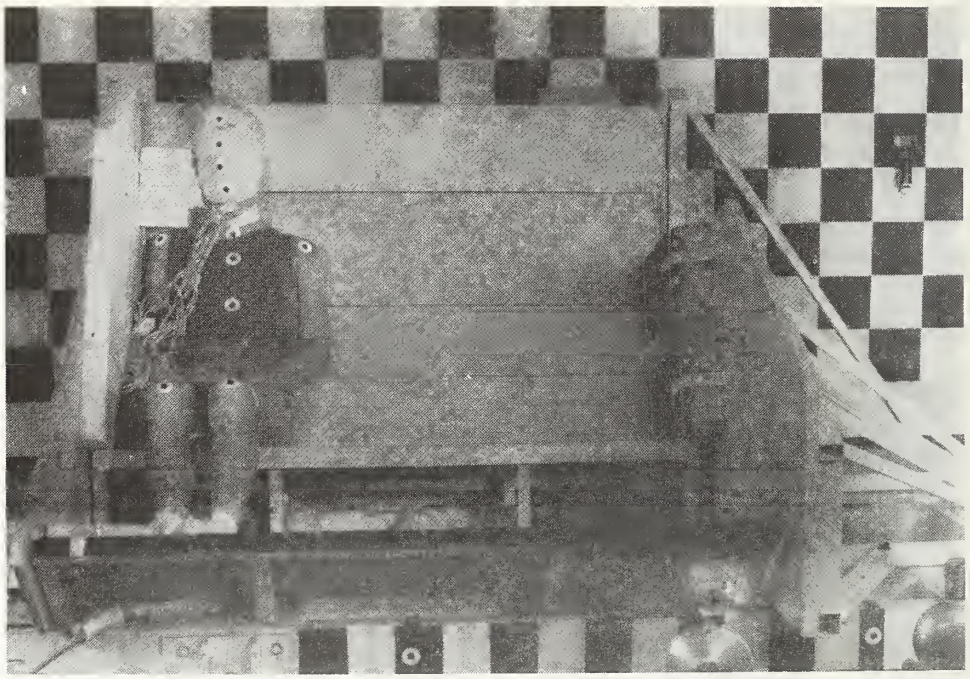

Fig. 3 Impact sled configuration for side impact tests (wall with 3,5" thick HNCB pad = fiber glass matrix without shoulder and pelvis force measurement)

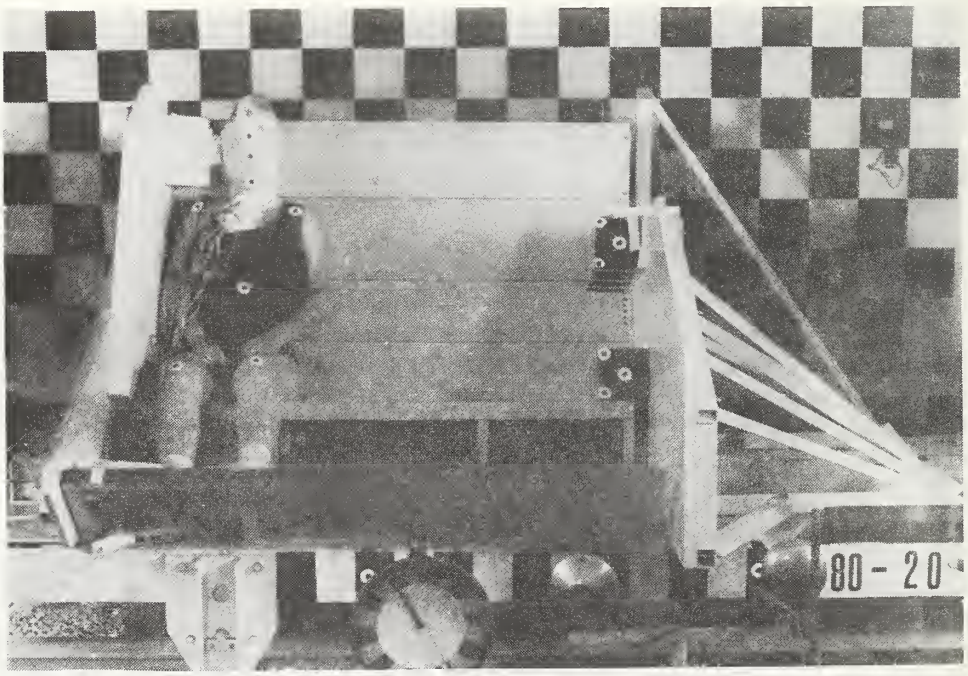

Fig. 4 Impact sled configuration for side impact tests (wall with APR pad = 5,5" high and 5,5" deep open cell urethane block without shoulder and pelvis force measurement)

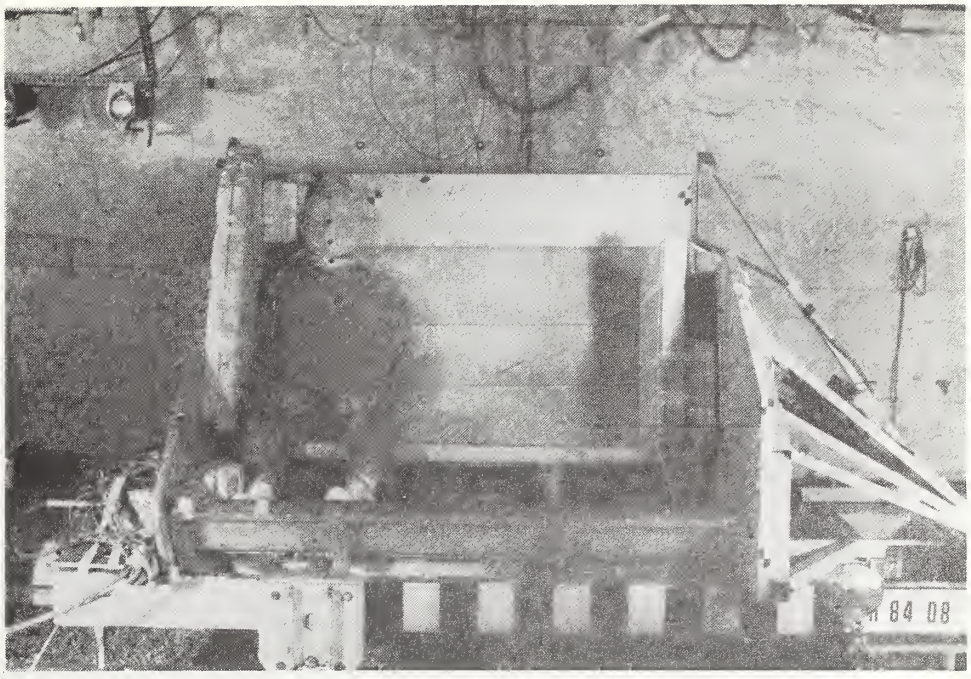

Fig. 5 Impact sled configuration for side impact tests (wall with 2" Ensolite pad with shoulder and pelvis force measurement)

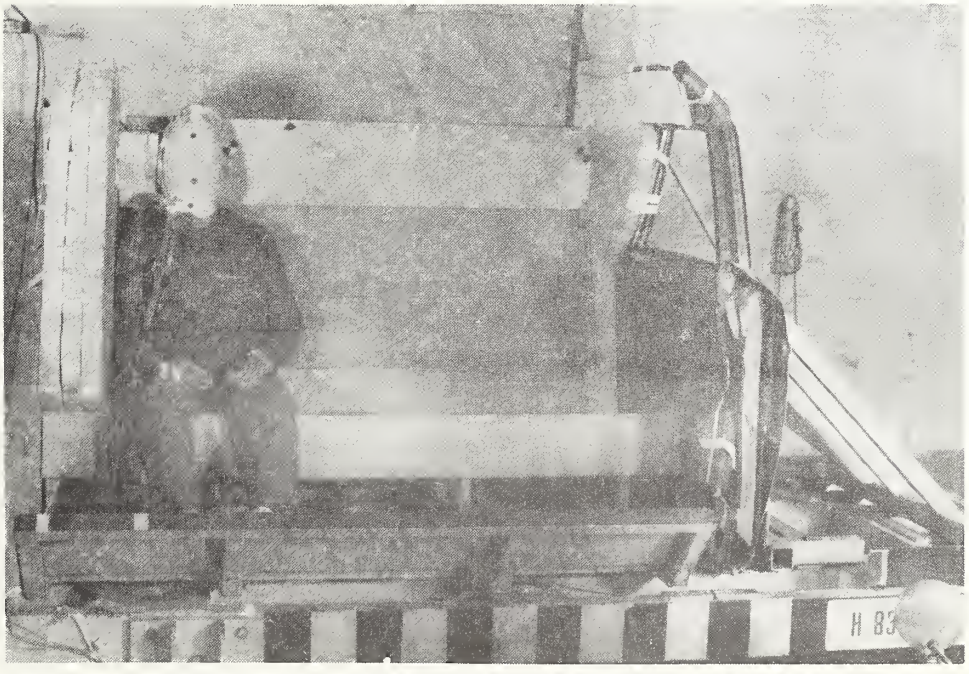

Fig. 6 Impact sled configuration for side impact tests (Volvo door without shoulder and pelvis force measurement)

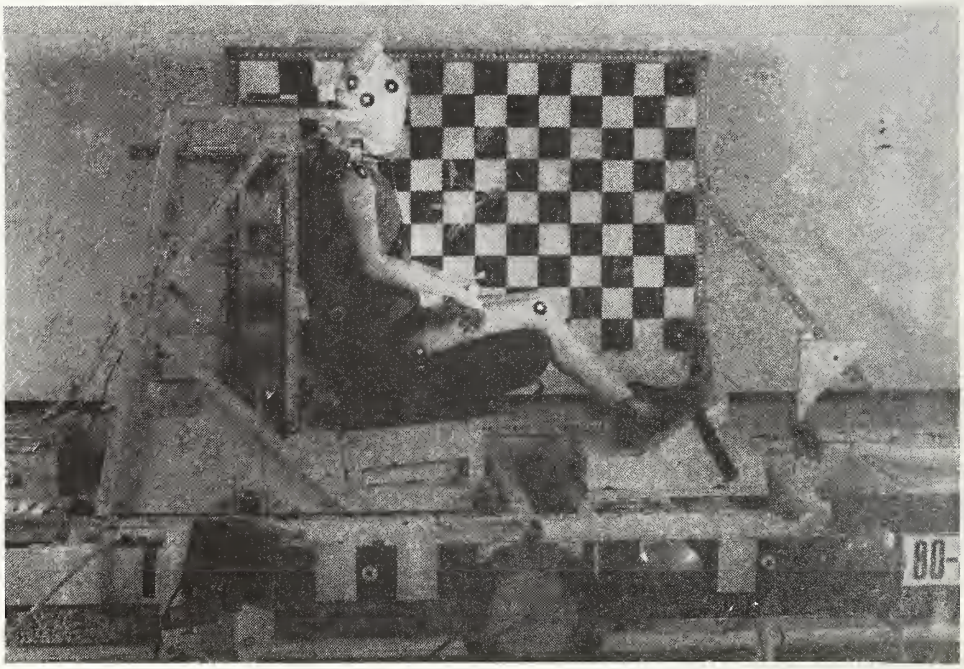

Fig. 7 Deceleration sled with test subject and restraint system

Test subject	impact veloc. km / h	impact typ	impact area spezif.	Numbers of Tests
Cadaver	24	Side imp.	Rigid Wall	7
Cadaver	32	Side imp.	Rigid Wall	9
Cadaver	40	Side imp.	Rigid Wall	5
Cadaver	24	Side imp.	HNCB	2
Cadaver	32	Side imp.	HNCB	4
Cadaver	32	Side imp.	APR	5
Cadaver	32	Side imp.	Ens.2,6,12 ''	5
Cadaver	18	Side imp.	Volvo door	2
Cadaver	35	Side imp.	Volvo door	3
Cadaver	50	Front. imp.	3-Point belt	5
TOTAL				47

Table 1 : Test Matrix Lateral and Frontal Impacts
Cadaver Tests.

Run Number	impact veloc. km / h	impact area specif.
8101 D	23	Rigid Wall
8102 D	24	Rigid Wall
8103 D	24	A P R pad.
8104 D	24	A P R pad.
8105 D	32	Rigid Wall
8106 D	32	Rigid Wall
8301 D	27	Ensolite 6 ''
8302 D	32	Ensolite 6 ''
8303 D	32	Ensolite 12''
8304 D	24	Rigid Wall
8305 D	32	A P R Pad.
8306 D	32	Rigid Wall
8401 D	29	Ensolite 3 '' as left arm simulation
8402 D	32	Ensolite 2 '' as left arm simulation
8403 D	23	Ensolite 2 '' as left arm simulation
8404 D	32	Ensolite 1 '' as left arm simulation
8405 D	32	Rigid Wall

17 Dummy Tests

Table 2 : Test Matrix Lateral Impacts HSRI SID

Preparation of the Cadavers

Fresh unembalmed cadavers have been used. No cadavers subjected to trauma before testing have been used. The anthropometrical data are given under Results.

In an effort to assess the bone condition in the skeleton, bending tests of the 6th and 7th rib right have been performed.

The vascular system has not been pressurized, perfusion with ink has not been performed. The lungs have been pressurized with air to 35-45 mm HG and the trachea then closed.

X-Ray pictures have been taken pre and post impact. A full autopsy with a detailed investigation of the vertebral column (Schmidt et al, 1978, Mattern 1980) has been performed after each test. The injury severity was scaled in accordance with AIS 1976 (1980).

Instrumentation

Sled: deceleration in x-direction, thorax and pelvis force (load cells were placed at the wall (Fig. 8), from Run Nos 8208 - 8222, eleven cadaver tests and from Run Nos 8301D, eleven HSRISID tests).

Test Subjects:
Head: a nine accelerometer module (Padgaonkar 1976).
Thorax: the 12-accelerometer array (Eppinger et al 1978), lung pressure (in cadavers tests).
Pelvis: acceleration 3-axial.
In the frontal collisions the shoulder and lap belt forces have been additionally measured.

Photographic Documentation
For the lateral collision a high speed film from the lateral view was taken and for the frontal collision from two views, frontal and side view. Photos were taken before and after the test. Further photos were made of the anterior - posterior and lateral x-rays of the head.

Measuring Data Recording - Evaluation

The data are recorded by using a multiplexed FM recorder. The data are subsequently digitized at 1600 samples per second and digitally filtered by using a finite impulse response filter having a pass band frequency of 100 Hz, and a stop band frequency of 189 Hz and a stop band attenuation of -50db. The digitization of the analog data was made by the WSU Detroit, the further evaluation by NHTSA.

Results

The evaluation of the measuring data of the most important measuring locations for each of the test series as mean response with +/- 1 st. deviation corridor can be seen in Appendix I - Appendix IX. A summary of all results of the anthropometrical data, impact conditions, the rib fractures, the AIS severity and the bending tests of the 6th and 7th rib for each test series in included in Tab. 3. Details about injuries of the test subjects can be found in Appendix I - Appendix VIII.

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
				FRONTAL IMPACT					
H 8001	male	38	70	171	56	64	39	30	91
H 8002	female	32	61	172	52	62	31	22	82
H 8005	male	25	80	200	57	68	38	29	95
H 8006	female	34	48	157	54	64	32	24	80
H 8008	male	19	66	180	56	66	36	28	87
				SIDE IMPACT					
H 8011	male	27	89	180	56	67	44	33	93
H 8013	male	33	95	180	58	68	35	27	101
H 8014	female	60	84	169	52	64	50	33	102
H 8017	male	38	70	175	55	65	36	24	86
H 8018	male	21	61	166	58	63	37	27	38
H 8020	female	26	67	167	57	66	36	25	80
H 8021	male	29	63	180	56	60	39	29	90
H 8023	female	41	82	159	54	66	40	32	94
H 8024	male	24	85	176	56	64	40	29	85
H 8102	male	57	65	165	55	63	43	26	90
H 8104	male	56	80	165	54	66	40	29	95
H 8106	male	37	82	170	59	66	48	31	100
H 8111	male	43	59	165	55	62	41	26	87
H 8112	female	33	46	156	54	57	33	27	74
H 8115	male	44	73	172	52	70	34	28	92
H 8116	male	22	77	174	56	64	42	28	93
H 8121	female	48	57	166	54	62	32	24	82
H 8122	male	23	76	178	57	66	41	30	90
H 8125	male	38	65	177	57	67	42	29	86
H 8127	male	30	77	180	55	67	36	26	89
H 8202	male	47	68	165	53	63	39	30	98
H 8208	male	61	99	172	56	70	47	35	106
H 8209	female	27	51	166	53	62	31	23	76
H 8212	male	17	75	172	54	66	44	32	96
H 8214	female	22	61	178	55	63	34	22	83
H 8215	male	18	69	182	54	62	38	28	85
H 8216	male	21	50	187	58	66	37	25	84
H 8218	female	28	65	181	58	68	37	30	89
H 8219	female	47	67	165	54	61	34	26	85
H 8230	male	41	73	180	55	66	39	27	89
H 8221	male	48	99	180	55	63	44	31	106
H 8228	male	50	77	167	55	64	38	28	95
H 8308	male	45	78	178	55	63	38	30	100
H 8310	female	30	58	176	54	57	32	24	80
H 8311	male	26	61	188	58	62	31	22	87
H 8312	male	34	77	178	54	63	36	28	92
H 8316	male	52	88	171	55	66	38	29	89
H 8320	female	17	52	153	51	59	32	24	72
H 8321	male	38	58	165	53	63	36	25	84
H 8330	male	42	86	187	56	68	37	25	97
H 8331	male	43	67	170	54	65	35	25	87
H 8408	male	79	64	168	57	65	42	30	98

Table 3. Summary of all results of the anthropometrical data, impact conditions, the rib fractures, the AIS severity and the bending tests of the 6th and 7th rib for each test series.

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
				FRONTAL IMPACT				
H 8001	22	32	80	66	91	55	49	96
H 8002	18	27	68	72	100	54	48	94
H 8005	23	33	79	80	106	66	62	113
H 8006	17	28	63	64	87	51	44	87
H 8008	22	30	69	68	93	58	55	100
				SIDE IMPACT				
H 8011	21	30	87	74	100	60	49	100
H 8013	28	35	98	77	97	60	55	103
H 8014	24	34	94	66	88	56	52	98
H 8017	20	30	76	71	94	62	55	105
H 8018	23	30	75	69	90	57	50	96
H 8020	19	28	75	72	95	57	48	93
H 8021	22	31	78	68	94	54	50	98
H 8023	24	33	98	71	94	55	49	90
H 8024	22	29	75	65	90	62	53	93
H 8102	24	32	82	69	94	37	49	76
H 8104	25	32	93	71	92	55	46	92
H 8106	25	34	90	63	86	40	45	79
H 8111	22	28	81	63	85	52	51	95
H 8112	18	26	72	63	82	53	44	90
H 8115	23	32	82	70	91	55	51	96
H 8116	22	32	85	67	97	58	52	99
H 8121	21	28	81	65	87	54	50	93
H 8122	23	30	80	73	100	56	51	97
H 8125	21	28	76	70	96	52	62	102
H 8127	22	31	76	69	91	60	54	100
H 8202	23	32	85	68	90	56	48	94
H 8208	28	38	113	75	98	57	54	98
H 8209	18	28	67	64	90	55	48	93
H 8212	33	34	88	65	86	50	50	80
H 8214	20	29	78	68	94	62	54	102
H 8215	19	29	73	71	96	64	56	101
H 8216	20	27	71	73	100	60	56	102
H 8218	24	29	92	77	100	60	55	105
H 8219	21	31	79	66	88	54	46	90
H 8220	22	32	76	70	94	60	54	104
H 8221	26	36	102	73	94	61	56	106
H 8222	22	33	85	72	93	55	52	86
H 8308	24	33	96	72	95	62	55	102
H 8310	17	27	78	70	93	59	52	103
H 8311	21	31	75	71	96	65	58	111
H 8312	22	32	89	76	95	58	53	102
H 8316	22	30	77	68	92	57	54	101
H 8320	18	25	62	62	83	54	45	88
H 8321	21	29	79	67	92	53	49	91
H 8330	24	34	89	74	98	65	58	108
H 8331	24	30	77	68	90	58	53	97
H 8408	26	34	99	69	90	57	51	97

Continue Table 3.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
			FRONTAL IMPACT						
H 8001	-----	50	5	0	0	0	5	5	0
H 8002	-----	50	3	1	1	0	2	2	0
H 8005	-----	49	5	5	5	0	0	0	0
H 8006	-----	51	4	1	1	0	3	3	0
H 8008	-----	49	2	2	2	0	0	0	0
			SIDE IMPACT						
H 8011	rig.wall	24	1	1	1	0	0	0	0
H 8013	rig.wall	25	7	7	7	0	0	0	0
H 8014	rig.wall	23	4	4	4	0	0	0	0
H 8017	rig.wall	24	7	7	0	7	0	0	0
H 8018	APR pad	31	0	0	0	0	0	0	0
H 8020	APR pad	30	3	3	0	3	0	0	0
H 8021	HNCB pad	32	0	0	0	0	0	0	0
H 8023	HNCB pad	33	11	11	8	3	0	0	0
H 8024	rig.wall	33	0	0	0	0	0	0	0
H 8102	rig.wall	33	28	23	8	15	5	5	0
H 8104	rig.wall	32	36	25	6	19	11	4	7
H 8106	rig.wall	32	16	16	8	8	0	0	0
H 8111	HNCB pad	32	0	0	0	0	0	0	0
H 8112	HNCB pad	32	5	5	4	1	0	0	0
H 8115	HNCB pad	23	0	0	0	0	0	0	0
H 8116	rig.wall	40	15	15	7	8	0	0	0
H 8121	HNCB pad	24	0	0	0	0	0	0	0
H 8122	rig.wall	40	22	21	9	12	1	0	1
H 8125	rig.wall	32	15	15	7	8	0	0	0
H 8127	rig.wall	40	9	9	7	2	0	0	0
H 8202	rig.wall	32	20	20	11	9	0	0	0
H 8208	APR pad	31	18	15	7	8	3	2	1
H 8209	rig.wall	40	21	20	1	19	1	0	1
H 8212	rig.wall	40	17	17	7	10	0	0	0
H 8214	rig.wall	32	18	18	6	12	0	0	0
H 8215	rig.wall	23	2	2	0	2	0	0	0
H 8216	rig.wall	31	11	11	3	8	0	0	0
H 8218	rig.wall	23	9	9	7	2	0	0	0
H 8219	rig.wall	23	7	7	7	0	0	0	0
H 8220	rig.wall	31	20	17	9	8	3	1	2
H 8221	APR pad	32	25	21	9	12	4	1	3
H 8222	APR pad	32	25	20	5	15	5	2	3
H 8308	Volvodoor	16	0	0	0	0	0	0	0
H 8310	6'' Ens	27	0	0	0	0	0	0	0
H 8311	12''Ens	31	0	0	0	0	0	0	0
H 8312	6'' Ens	32	0	0	0	0	0	0	0
H 8316	Volvodoor	35	13	9	4	5	4	2	2
H 8320	6'' Ens	31	0	0	0	0	0	0	0
H 8321	Volvodoor	36	24	20	8	12	4	4	0
H 8330	Volvodoor	18	0	0	0	0	0	0	0
H 8331	Volvodoor	27	13	13	0	13	0	0	0
H 8405	2'' Ens	32	19	19	8	11	0	0	0

Continue Table 3.

AIS - SEVERITY

Run No	Body Surface	Head	Thorax	Abdomen	Pelvis	Spine	Extrem.	MAIS
			FRONTAL IMPACT					
H 8001	0	0	3	1	0	2	0	3
H 8002	0	0	3	1	0	3	0	3
H 8005	0	0	3	0	0	0	0	3
H 8006	0	0	3	0	0	3	0	3
H 8008	0	0	3	1	0	2	0	3
			SIDE IMPACT					
H 8011	0	0	0	0	0	2	0	2
H 8013	0	2	3	0	0	2	0	3
H 8014	0	1	3	0	0	3	0	3
H 8017	0	0	3	0	0	1	0	3
H 8018	0	3	3	0	0	1	0	3
H 8020	0	0	1	0	0	1	0	1
H 8021	0	0	0	0	0	1	0	1
H 8023	0	0	3	0	0	1	0	3
H 8024	0	0	0	0	0	0	0	0
H 8102	0	4	4	4	0	2	0	4
H 8104	0	0	4	4	0	2	0	4
H 8106	0	0	3	0	0	1	1	3
H 8111	0	0	0	0	0	2	0	2
H 8112	0	1	3	0	0	0	0	3
H 8115	0	0	0	0	0	1	0	1
H 8116	0	0	4	5	0	1	0	5
H 8121	0	0	0	0	0	1	1	1
H 8122	0	0	4	4	0	0	0	4
H 8125	1	0	4	5	0	2	0	5
H 8127	0	0	3	5	0	2	0	5
H 8202	1	0	4	5	0	2	0	5
H 8208	0	0	0	4	5	4	2	5
H 8209	1	0	5	2	3	1	3	5
H 8212	1	0	5	5	0	0	2	5
H 8214	0	0	4	5	3	1	1	5
H 8215	0	0	1	0	0	0	1	1
H 8216	0	0	3	0	0	1	2	3
H 8218	0	0	3	0	0	1	0	3
H 8219	0	0	3	0	0	1	0	3
H 8220	0	0	4	5	2	0	1	5
H 8221	0	0	4	0	0	1	0	4
H 8223	0	0	4	5	0	2	0	5
H 8308	0	0	0	0	0	0	0	0
H 8310	0	0	0	0	0	2	0	2
H 8311	0	0	0	0	0	0	0	0
H 8312	0	0	0	0	0	1	0	1
H 8316	0	3	4	0	0	1	0	4
H 8320	0	0	0	0	0	0	0	0
H 8321	0	3	4	0	2	0	0	4
H 8330	0	0	0	0	0	0	0	0
H 8331	1	1	3	0	0	1	1	3
H 8408	0	0	4	0	0	2	0	4

Continue Table. 3.

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
			FRONTAL IMPACT			
H 8001	395	4.0	45.7	318	5.0	36.4
H 8002	235	-	32.4	236	6.0	32.3
H 8005	291	5.0	26.5	346	5.0	29.2
H 8006	178	6.6	26.6	200	6.2	31.7
H 8008	213	5.7	30.8	206	5.8	33.0
			SIDE IMPACT			
H 8011	-	-	-	-	-	-
H 8013	-	-	-	-	-	-
H 8014	-	-	-	-	-	-
H 8017	-	-	-	-	-	-
H 8018	-	-	-	-	-	-
H 8020	-	-	-	-	-	-
H 8021	-	-	-	-	-	-
H 8023	208	4.0	27.1	234	4.0	28.3
H 8024	274	5.0	28.5	269	3.4	36.7
H 8102	48	.8	24	111	2.8	26
H 8104	154	3.2	23	123	3.7	24
H 8106	205	3.4	33	334	3.8	44
H 8111	210	2.4	25	198	6.1	23
H 8112	54.4	3.0	24.6	89.6	2.8	24.3
H 8115	197	4.6	25	219	2.5	33
H 8116	448	3.7	42	352	3.8	42
H 8121	195	5.7	26	194	4.6	25
H 8122	298	5.6	36	311	4.9	43
H 8125	255	4.2	31	266	3.8	39
H 8127	291	4.5	34	386	5.5	50
H 8202	380	4.6	53	188	4.5	38
H 8206	104	2.0	27.0	-	-	-
H 8209	149	6.2	18.2	110	6.4	21.4
H 8212	254	7.0	31.2	315	6.8	44.9
H 8214	354	7.5	34.1	361	5.5	35.4
H 8215	160	3.2	25.6	224	4.0	26.2
H 8216	280	5.0	28.0	318	7.9	29.9
H 8218	112	2.2	22.2	184	4.9	21.6
H 8219	282	5.3	35.1	224	4.2	35.6
H 8220	216	3.8	25.9	152	3.2	22.1
H 8221	-	-	-	-	-	-
H 8222	138	3.15	28.6	158	3.4	27.9
H 8308	114	3.7	35.2	138	4.7	28.4
H 8310	296	2.45	34.7	280	2.25	48.0
H 8311	163.6	2.2	20.1	107.2	3.0	21.1
H 8312	215	5.8	39	228	4.0	29
H 8316	180	4.4	23	150	3.6	26
H 8320	240	7.4	35	172	8.2	28
H 8321	96	3.0	32	89	3.0	27
H 8330	213	3.4	32	333	4.0	40
H 8331	115	3.2	22	131	2.5	22
H 8408	346	3.6	48	200	5.0	37

Continue Table 3.

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APPENDIX I

LATERAL IMPACT CADAVER TESTS INTO A RIGID WALL

IMPACT VELOCITY :

24 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8011	male	27	89	180	56	67	44	33	93
H 8013	male	33	95	180	58	68	35	27	101
H 8014	female	60	84	169	52	64	50	33	102
H 8017	male	38	70	175	55	65	36	24	86
H 8215	male	18	69	182	54	62	38	28	85
H 8218	female	28	85	181	58	68	37	30	89
H 8219	female	47	67	165	54	61	34	26	85
7	M 4 F 3	35.9	79.9	176	55.3	65	39.1	28.7	91.6

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8011	21	30	87	74	100	60	49	100
H 8013	28	35	98	77	97	60	55	103
H 8014	24	34	94	66	88	56	52	98
H 8017	20	30	76	71	94	62	55	105
H 8215	19	29	73	71	96	64	56	101
H 8218	24	29	92	77	100	60	55	105
H 8219	21	31	79	66	88	54	46	90
7	22.4	31.1	85.57	71.7	94.7	59.4	52.6	100.3

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8011	rig.wall	24	1	1	1	0	0	0	0
H 8013	rig.wall	25	7	7	7	0	0	0	0
H 8014	rig.wall	23	4	4	4	0	0	0	0
H 8017	rig.wall	24	7	7	0	7	0	0	0
H 8215	rig.wall	23	2	2	0	2	0	0	0
H 8218	rig.wall	23	9	9	7	2	0	0	0
H 8219	rig.wall	23	7	7	7	0	0	0	0
7	rig.wall	23.6	5.3	5.3	3.7	1.6	0	0	0

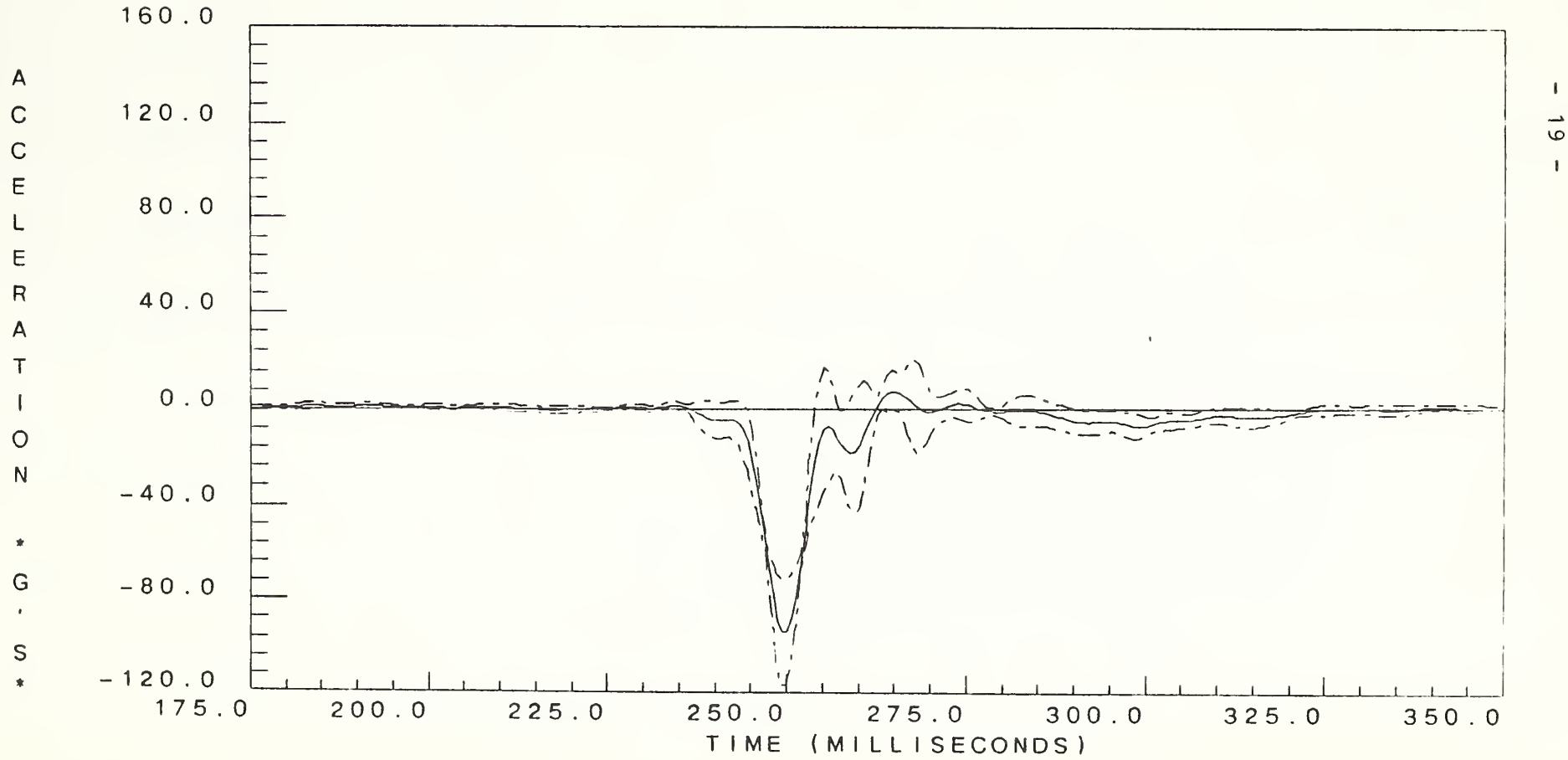
AIS - SEVERITY

Run No	Body Sur-face	Head	Thorax	Abdomen	Pelvis	Spine	Extrem .	MAIS
H 8011	0	0	0	0	0	2	0	2
H 8013	0	2	3	0	0	2	0	3
H 8014	0	1	3	0	0	3	0	3
H 8017	0	0	3	0	0	1	0	3
H 8215	0	0	1	0	0	0	1	1
H 8218	0	0	3	0	0	1	0	3
H 8219	0	0	3	0	0	1	0	3
7	0	.4	2	0	0	1	.1	3

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
H 8011	-	-	-	-	-	-
H 8013	-	-	-	-	-	-
H 8014	-	-	-	-	-	-
H 8017	-	-	-	-	-	-
H 8215	160	3.2	25.6	224	4.0	26.2
H 8218	112	2.2	22.2	184	4.9	21.6
H 8219	287	5.3	35.1	224	4.2	35.6
7	184.7	3.57	27.63	210.7	4.37	27.8

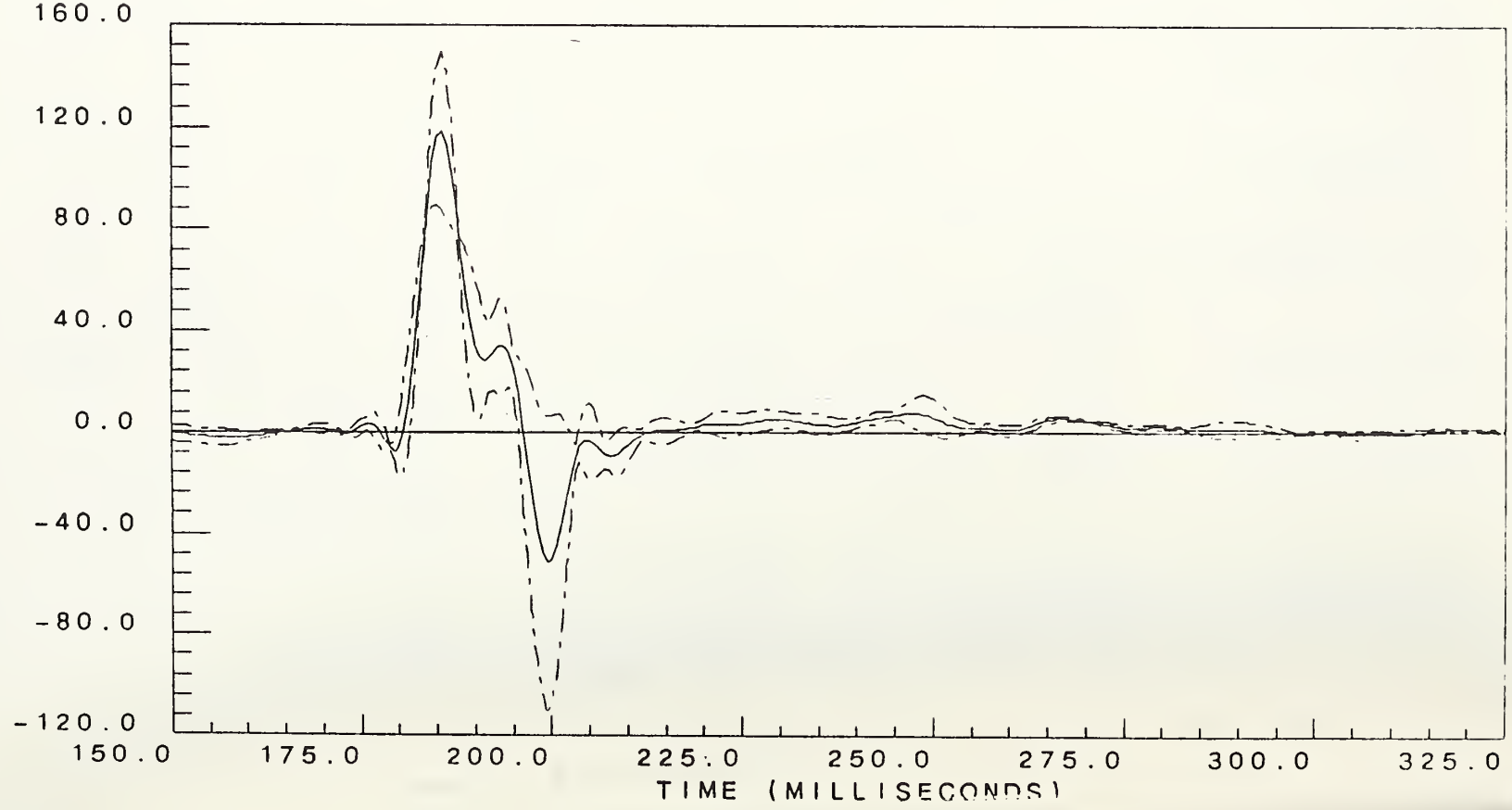
Mean Response with +/- 1 St. Dev. Corridor

15 MPH Rigid Wall, Upper Rib (Y)



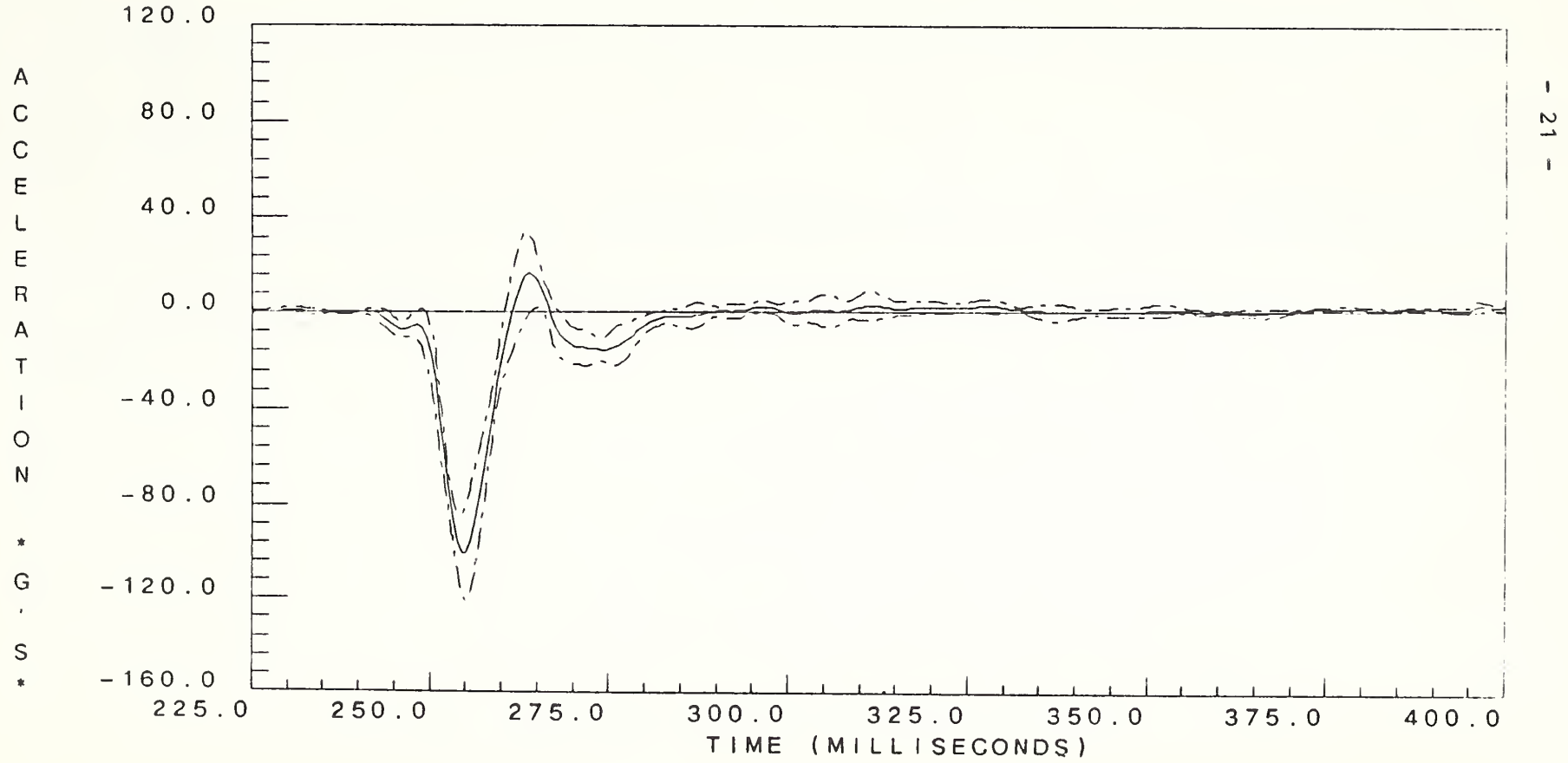
Mean Response with +/- 1 St. Dev. Corridor

15 MPH Rigid Wall, Lower Rib (Y)



Mean Response with +/- 1 St. Dev. Corridor

15 MPH Rigid Wall, Upper Spine (Y)



Mean Response with +/- 1 St. Dev. Corridor

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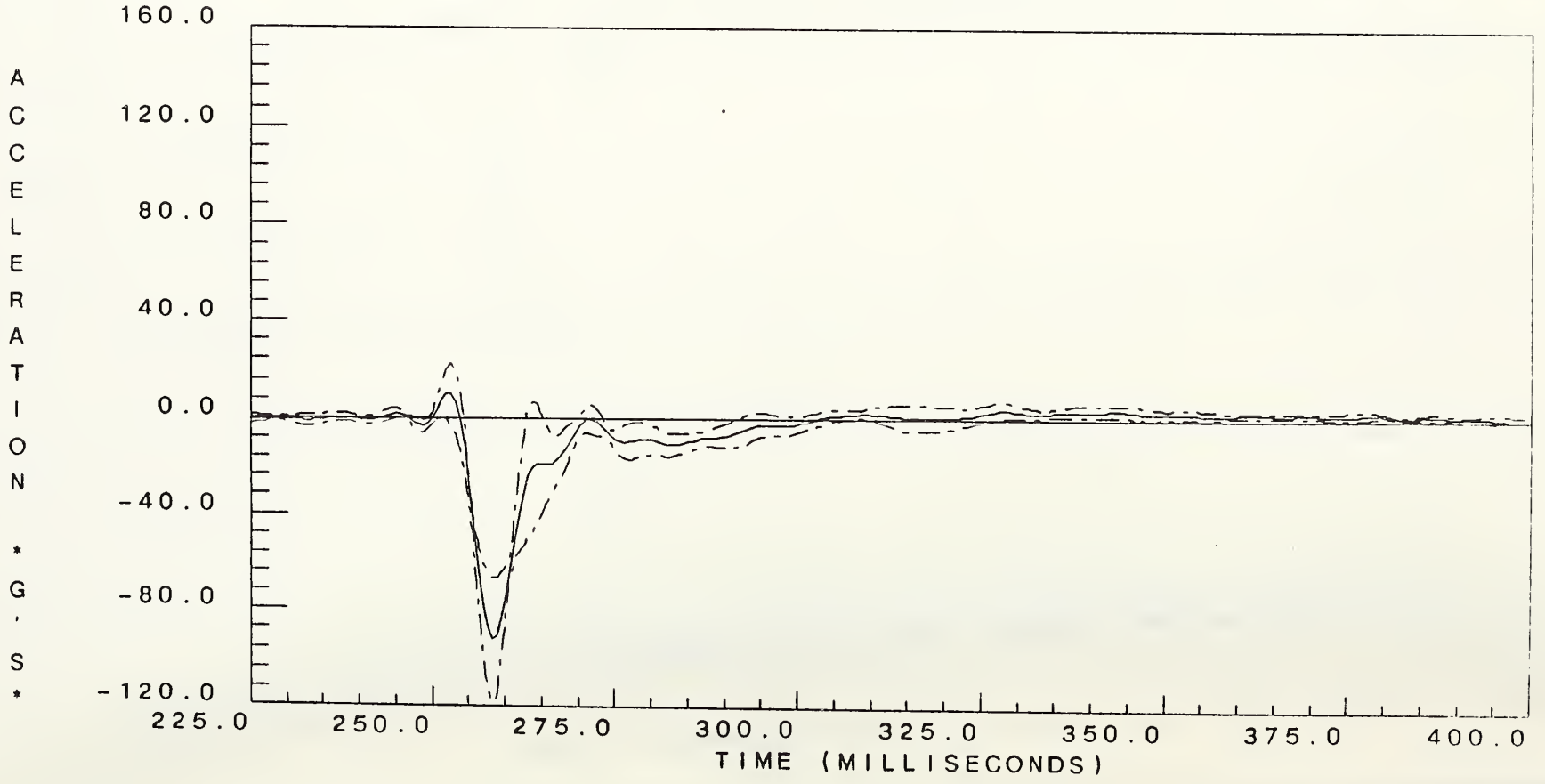
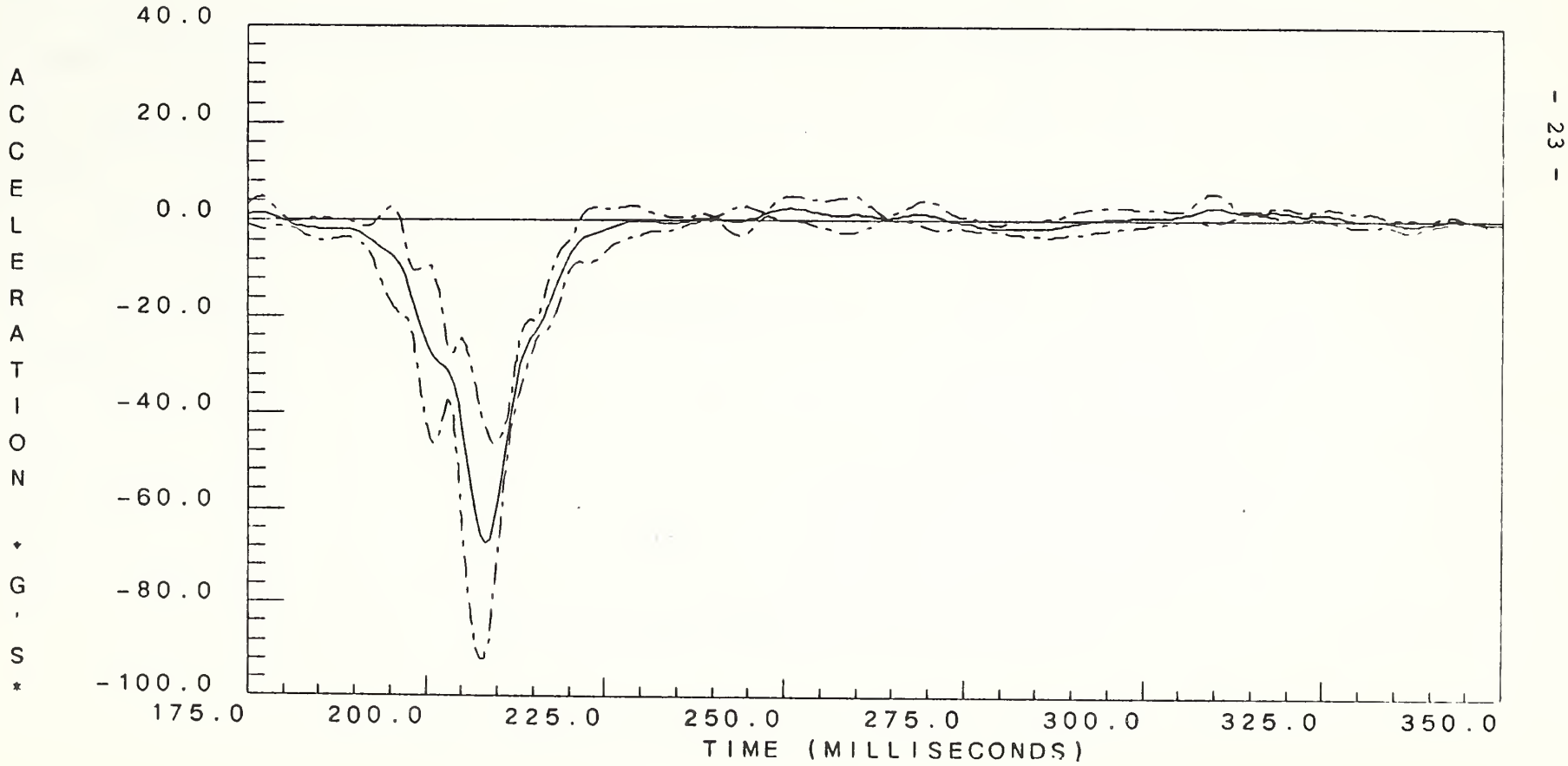


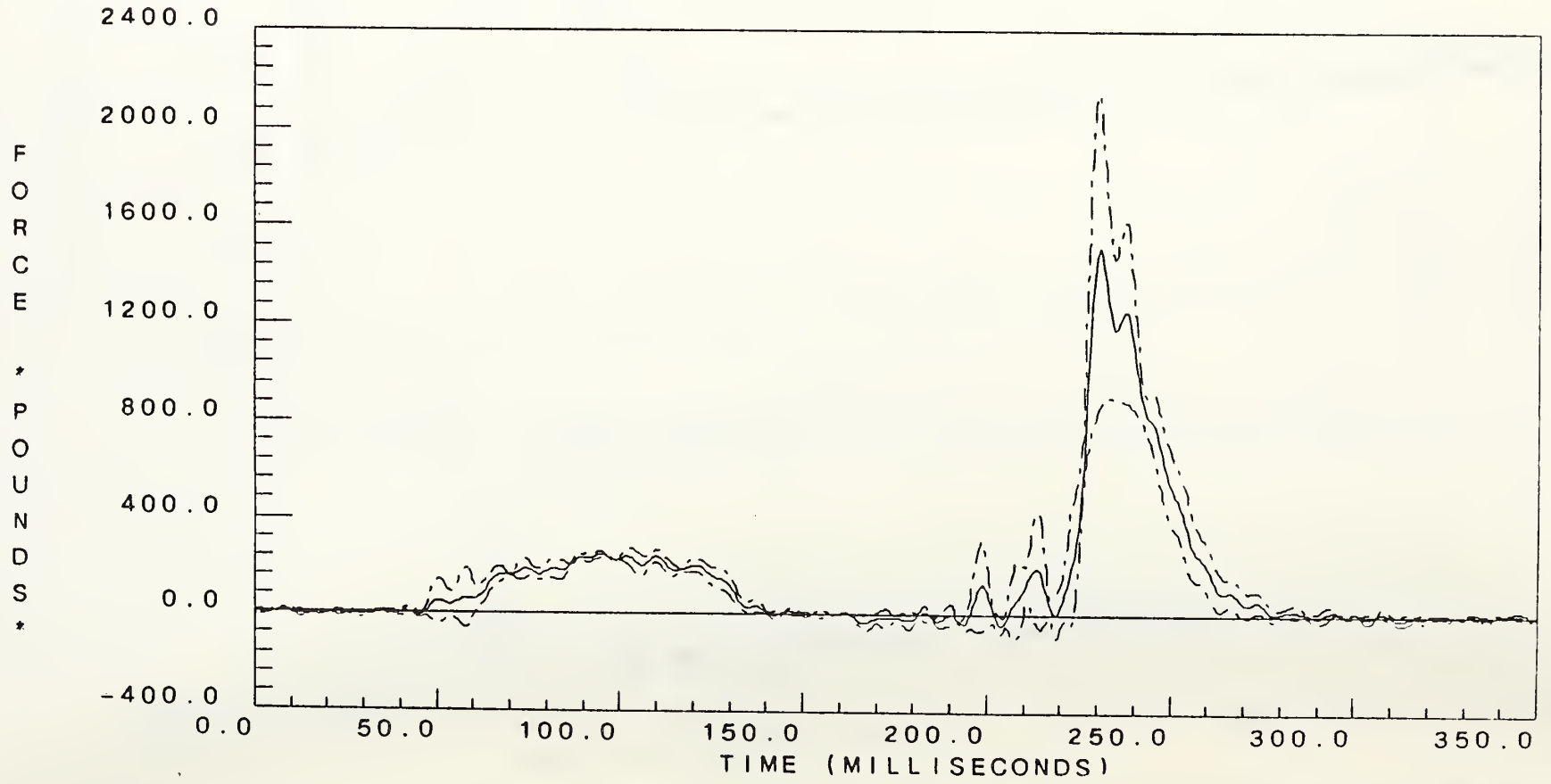
Mean Response with +/- 1 St. Dev. Corridor

15 MPH Rigid Wall, Pelvis Acc. (Y)



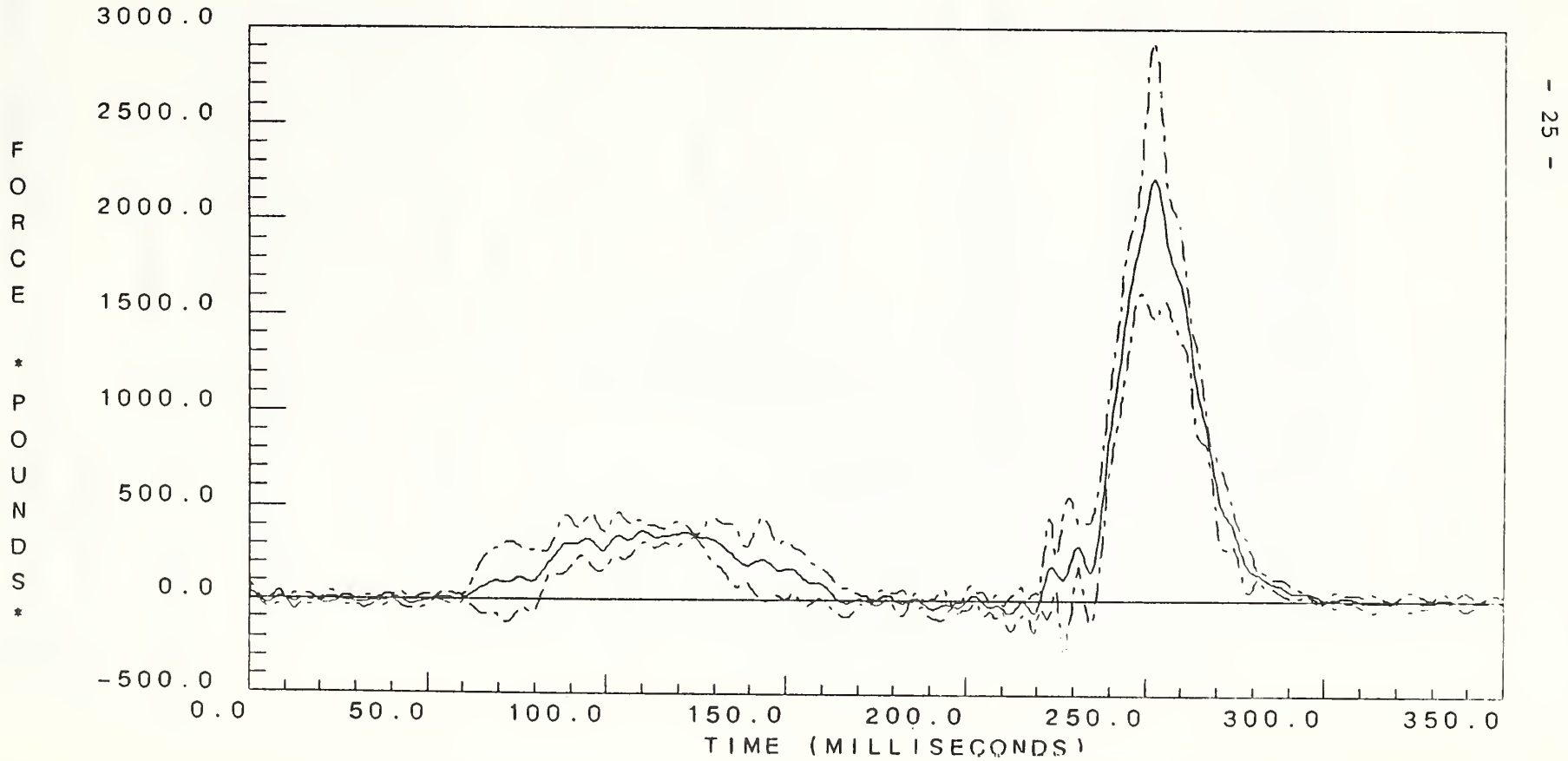
Mean Response with +/- 1 St. Dev. Corridor

15 MPH Rigid Wall, Pelvic Force (Y)



Mean Response with +/- 1 St. Dev. Corridor

15 MPH Rigid Wall, Shoulder Force (Y)



Run No. H 80 0 11

a) Subject:

Male, 27 years, body weight 89 kg, body length 180 cm (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions:

Lateral Collision - rigid wall -, impact velocity 24 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 2-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface: No injuries

Head: Skin abrasion over the left external ear. Hemorrhage of the sculp behind left ear. Hemorrhages of the leptomeninx on both hemisph ere surfaces.

Thorax: superficial muscle bleedings below of the left clavicle. Fracture of the 6th rib left (incl.).

Abdomen: No injuries

Vertebnal column: Hemorrhages of the paravertebral muscular system at both sides in the heigbt of C7 to Th 3. Laceration of the ligamentum flavum between Th 1 and Th 2 with laceration in the interspinal structures. Hemorrhages of the foramina intervertebralia left Th 1/ Th 2 and Th 3/Th 4.

Extremities: No injuries

e) Severity degree :

AIS-Head 0, AIS-Thorax 2, AIS-Abdomen 0, AIS-Vertebral Column 2, MAIS-2

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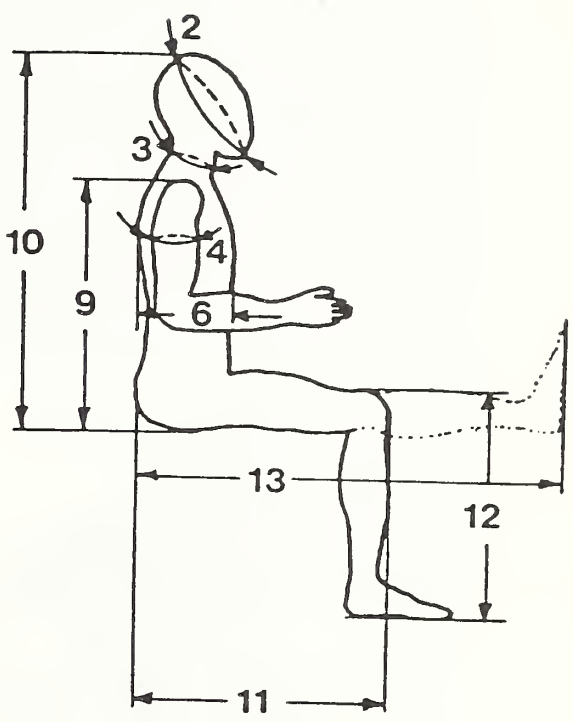
Run No. H 80 011

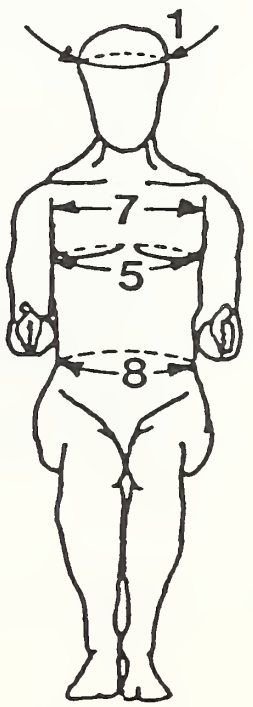
Anthropometrical Data

Body weight ..... 89 kg

Body length ..... 180 cm

1. Hat dimension ..... 56 ..cm
2. Head circumference..... 67,5 cm
3. Neck circumfer. ..... 44 ..cm
4. Upper arm circumfer. ..... 33 ..cm
5. Chest circumfer. ..... 93 ..cm
6. Chest height ..... 21 ..cm
7. Chest width ..... 30 ..cm
8. Abdomen circumfer. ..... 87 ..cm
9. Buttocks - shoulder ..... 74 ..cm
10. Seat height ..... 100 ..cm
11. Pelvis - knee ..... 60 ..cm
12. Sole of foot - knee ..... 49 ..cm
13. Pelvis - heal ..... 100 ..cm





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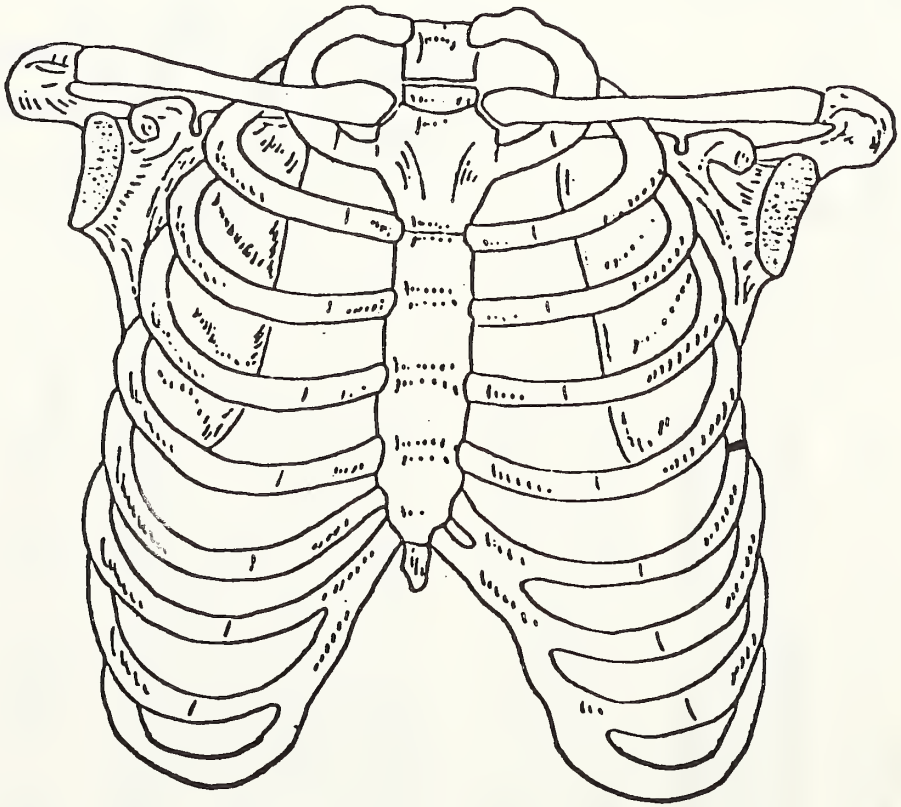
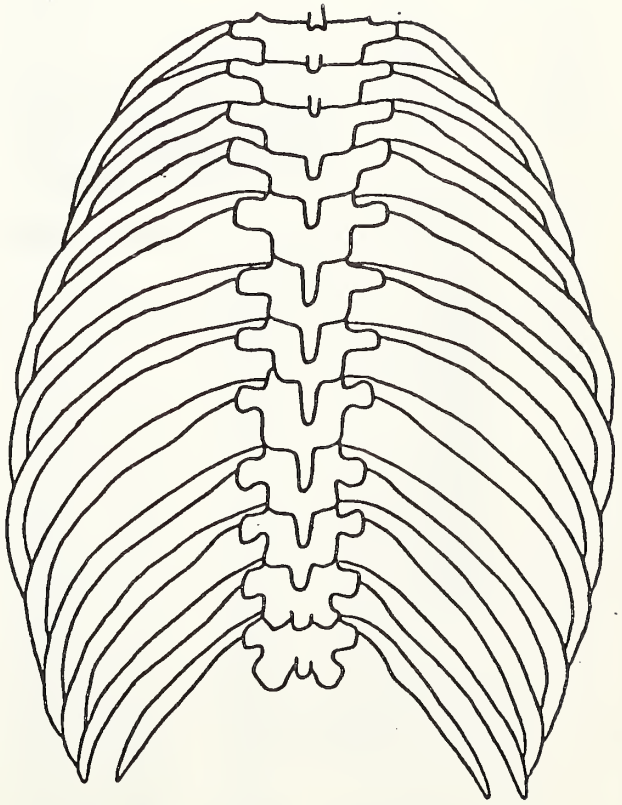
H 8o 11 DOT
Run No. .....





Number of rib fractures ...1...

Run No. H 80 013

a) Subject:

Male, 33 years, body weight 95 kg, body length 180 cm (further anthropometric data s. incl.),cause of death: internal bleeding.

b) Test conditions:

Lateral Collision - rigid wall -, impact velocity 25 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 2-accelerometer pelvis, lung pressure

d) Medical findings:

Body surface:	No injuries
Head:	muscle hemorrhage of the left temporal region, Fracture of the frontalbase of the skull
Thorax:	muscle hemorrhage left in the height of the 5th to 8th rib in the paravertebral region. Rib fractures of the 3rd up to 9th rib left.
Abdomen:	No injuries
Vertebral Column:	Dorsal epidural hemorrhage between Th 3 and Th 8. Hemorrhage between occiput and processus spinosus of the 2nd cervical vertebrae, left; hemorrhage into the intervertebral joint C1/C2 left and right.
Extremities:	No injuries

e) Severity degree:

AIS-Head 2, AIS-Thorax 3, AIS-Abdomen 0, AIS-Vertebral Column 2, MAIS-3

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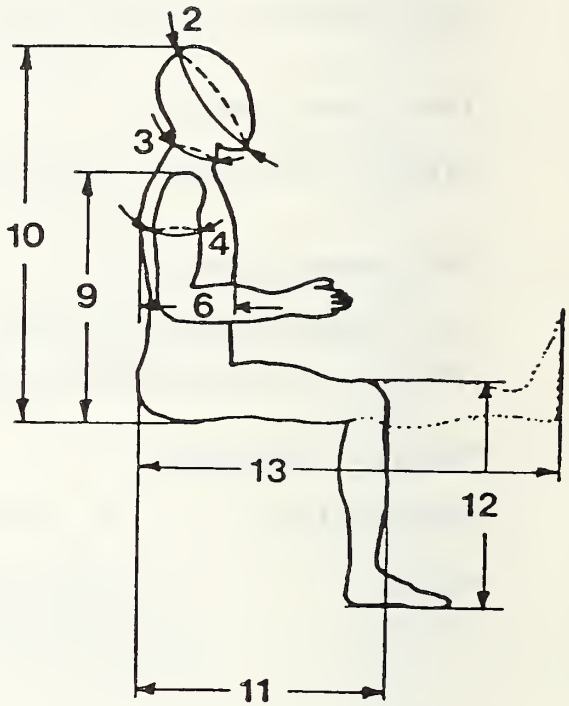
Run No. H.80.013..

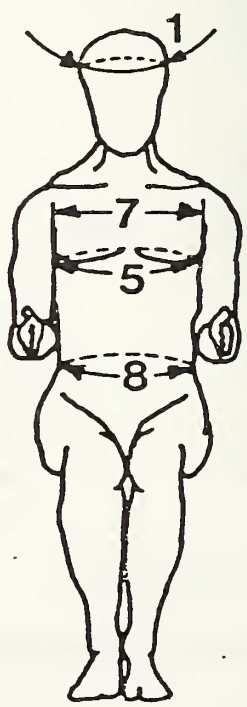
Anthropometrical Data

Body weight ..95.. kg

Body length ..178.. cm

1. Hat dimension ..58..cm
2. Head circumference..68..cm
3. Neck circumfer. ..35..cm
4. Upper arm circumfer. ..27..cm
5. Chest circumfer. ..101..cm
6. Chest height ..28..cm
7. Chest width ..35..cm
8. Abdomen circumfer. ..98..cm
9. Buttocks - shoulder ..77..cm
10. Seat height ..97..cm
11. Pelvis - knee ..60..cm
12. Sole of foot - knee ..55..cm
13. Pelvis - heal ..103..cm





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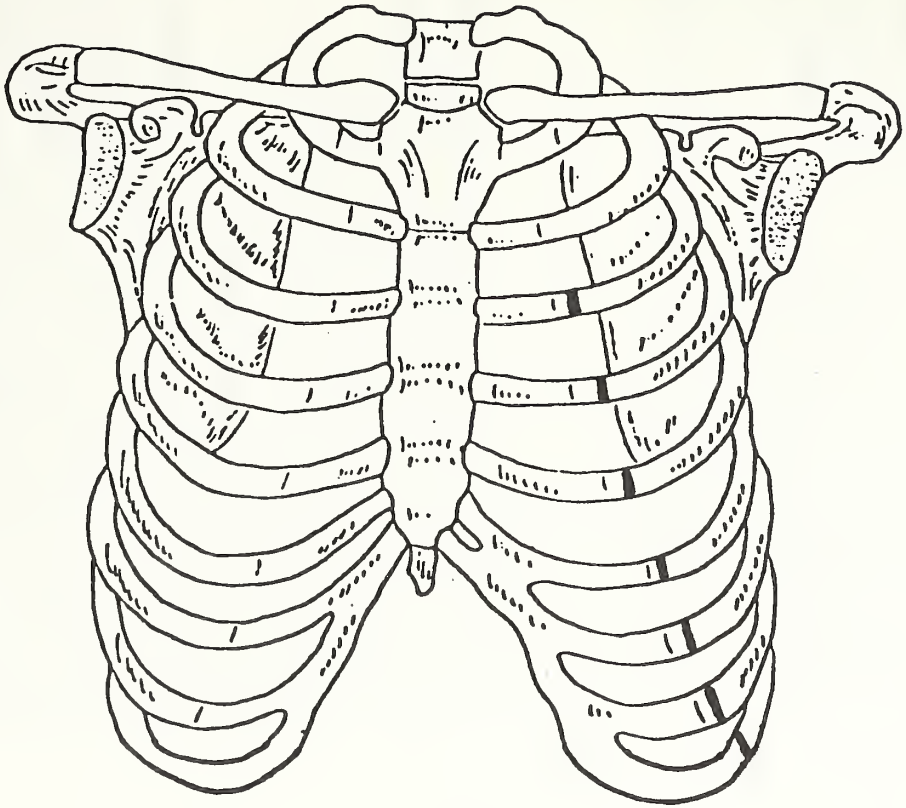
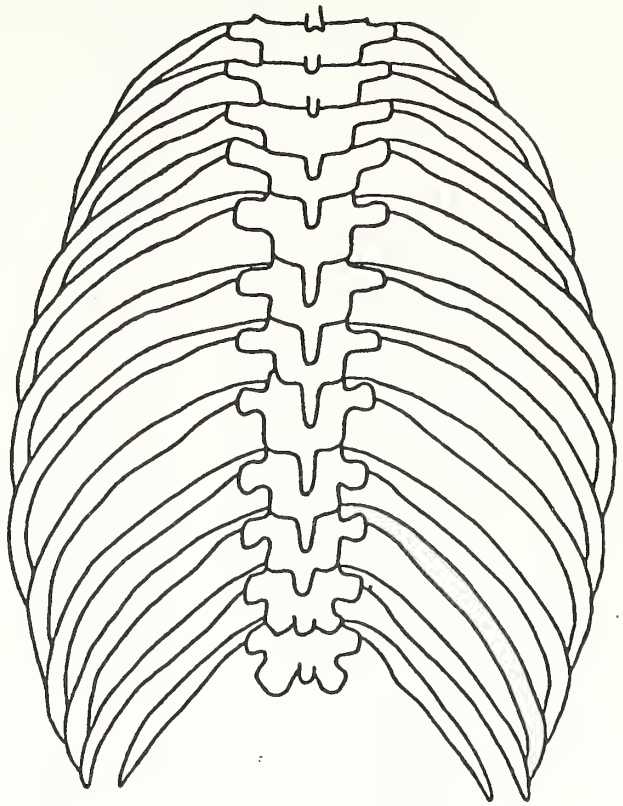
Run No. H 8o 13 DOT





Number of rib fractures 7

Run No. H 80 014

a) Subject:

Female, 60 years, body weight 84 kg, body length 169 cm (further anthropometric data s. incl.), cause of death: drown

b) Test conditions

Lateral Collision - rigid wall -, impact velocity 23 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 2-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	Skin Abrasion over the left upper arm
Head :	Hemorrhage of the scalp in the left and temporal region and in the right Sternocleido-mastoid-muscles.
Thorax:	Fractures of the 2nd, 5th and 6th rib two times left (incl.).
Abdomen:	No injuries
Vertebral Column:	Hemorrhages in the medium and deep muscle layer on both sides between occiput and C2. Extented hemorrhages of the intervertebral disc C4 ventral and dorsal; hemorrhages into the intervertebral discs C5/C6 and C6/C7. Hemorrhage in the dorsal epidural space from the occiput to Th 8. Hemorrhage of the dorsal interspinal space between occiput and C1. The interspinal space C7/Th 1 and Th 1/Th 2 is bleeded in and slackened, also the dorsal interspinal space Th 2/Th 3. The ligamentum flavum is lacerated inthis segment; however only at the right side.

At the right side cut hemorrhage in the joints Th 1/Th 2 and Th 2/Th 3 in the last mentioned segment also weak hemorrhage into the foramen intervertebrale. At the left side cut hemorrhages into the foramina intervertebralia C7/Th 1 and Th 1/Th 2, furthermore into the side joints C7/Th 1, Th 1/Th 2 and Th 2/Th 3.

Extremities: Hemorrhages in the left deltoid muscle.

e) Severity degree :

AIS-Head 1, AIS-Thorax 3, AIS Abdomen 0, AIS-Vertebral Column 3, MAIS-3.

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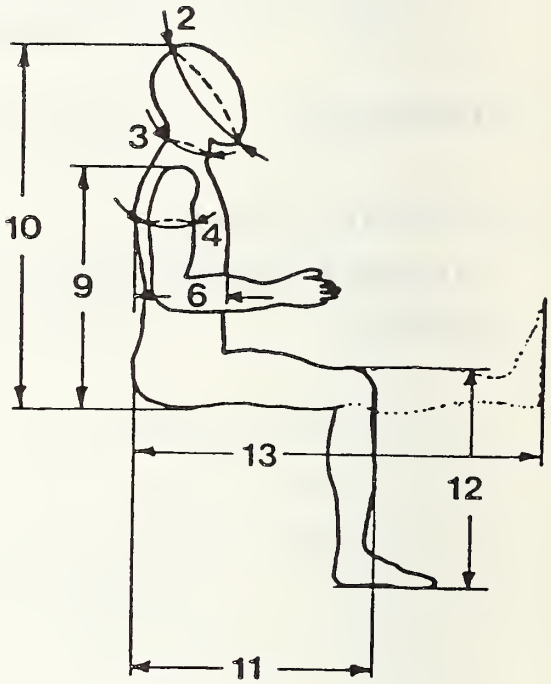
Run No. H 80 014

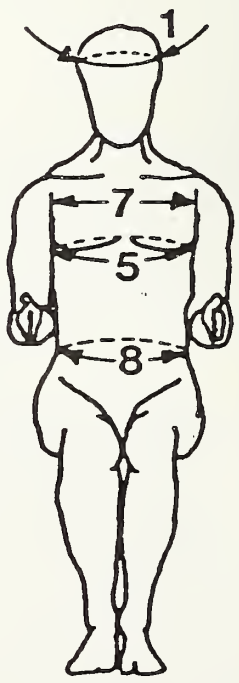
Anthropometrical Data

Body weight ..... 84 kg

Body length ..... 169 cm

1. Hat dimension ..... 52 ..cm
2. Head circumference..... 64 ..cm
3. Neck circumfer. ..... 50 ..cm
4. Upper arm circumfer. ... 33 ..cm
5. Chest circumfer. ..... 102 ..cm
6. Chest height ..... 24 ..cm
7. Chest width ..... 34 ..cm
8. Abdomen circumfer. ..... 94 cm
9. Buttocks - shoulder ..... 66 ..cm
10. Seat height ..... 88 cm
11. Pelvis - knee ..... 56 ..cm
12. Sole of foot - knee ..... 52 ..cm
13. Pelvis - heal ..... 98 ..cm





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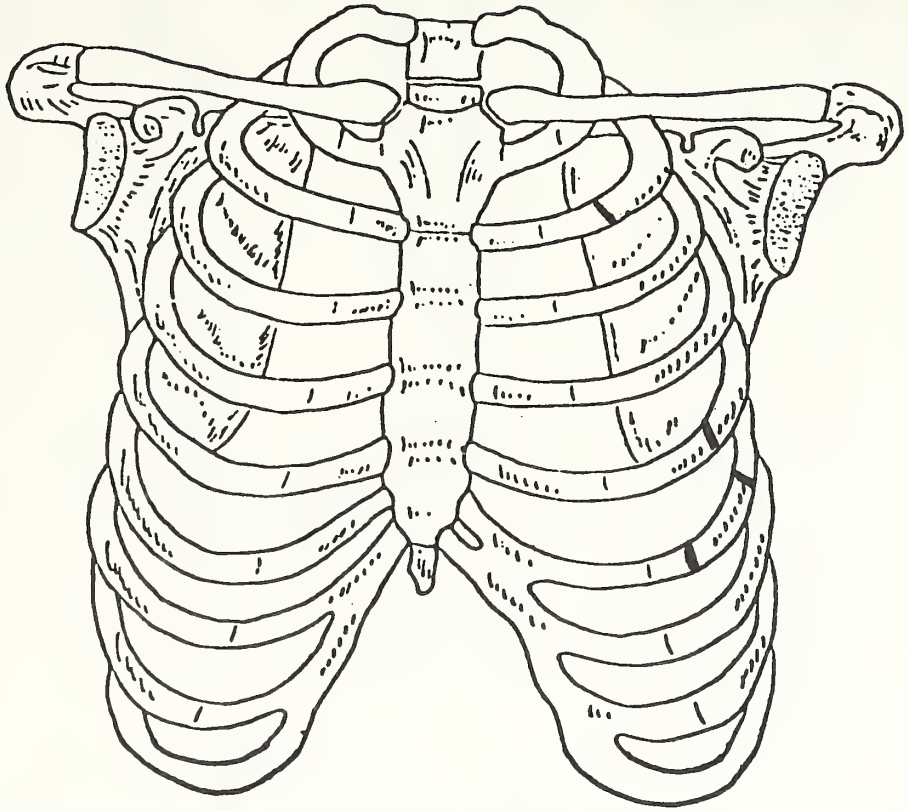
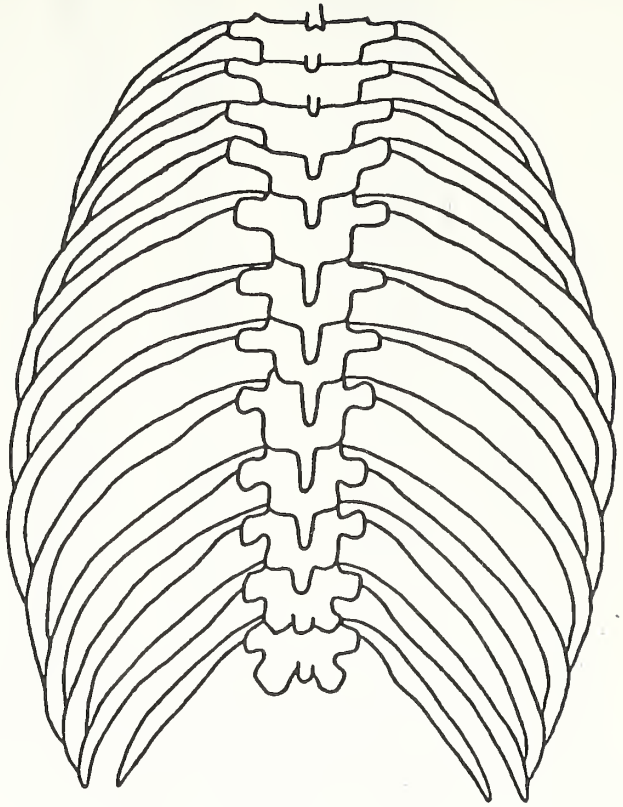
Run No. H 8o 14 DOT





Number of rib fractures 4

Run No. H 80 0 17

a) Subject:

Male, 38 years, body weight 70 kg, body length 175 cm (further anthropometric data s. incl.), cause of death: cardial infarct.

b) Test conditions:

Lateral collision - rigid wall -, impact velocity 24 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 2-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	Skin abrasion over the left lower arm.
Head:	No injuries.
Thorax:	Fracture of the 3rd rib two times, fracture of the 4th, 5th, 6th, 7th and 8th rib left (all fractures left, incl).
Abdomen:	No injuries.
Vertebral Column:	Hemorrhage and subluxation in the side joint left between C7/Th1. Small hemorrhage in the interspinal space C7/Th1.
Extremities:	No injuries.

e) Severity degree: AIS head 0, AIS thorax 3, AIS abdomen 0. AIS vertebral column 1, MAIS 3.

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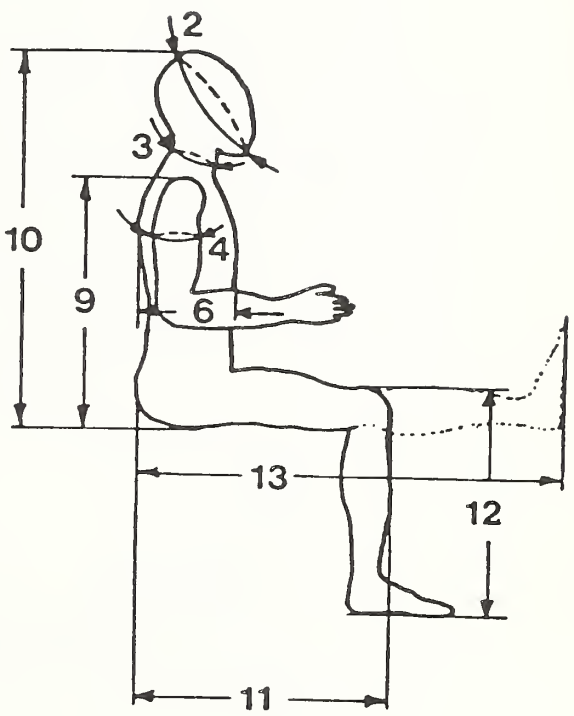
Run No. H 8o 017 .....

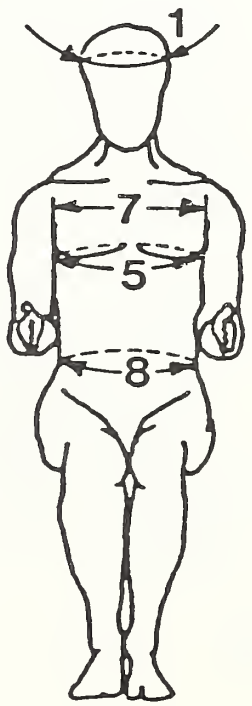
Anthropometrical Data

Body weight ....7o kg

Body length .....175 cm

1. Hat dimension .....55.....cm
2. Head circumference.....65.....cm
3. Neck circumfer. .....36.....cm
4. Upper arm circumfer. .....24.....cm
5. Chest circumfer. .....86.....cm
6. Chest height .....2o.....cm
7. Chest width .....3o.....cm
8. Abdomen circumfer. .....76.....cm
9. Buttocks - shoulder .....71.....cm
10. Seat height .....94.....cm
11. Pelvis - knee .....62.....cm
12. Sole of foot - knee .....55.....cm
13. Pelvis - heal .....1o5.....cm





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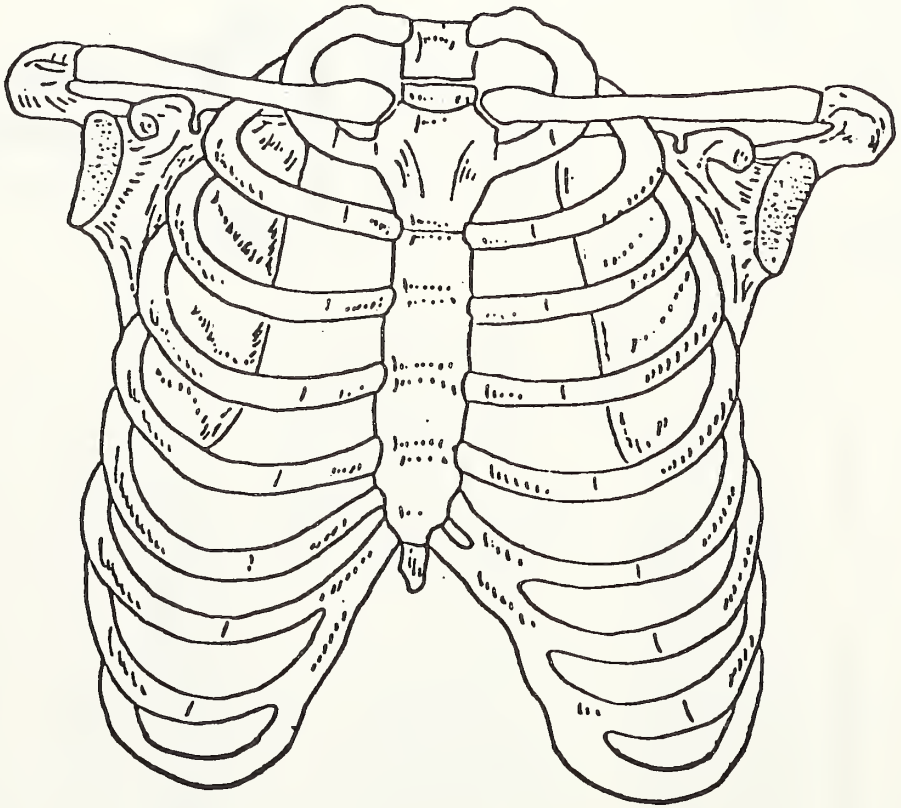
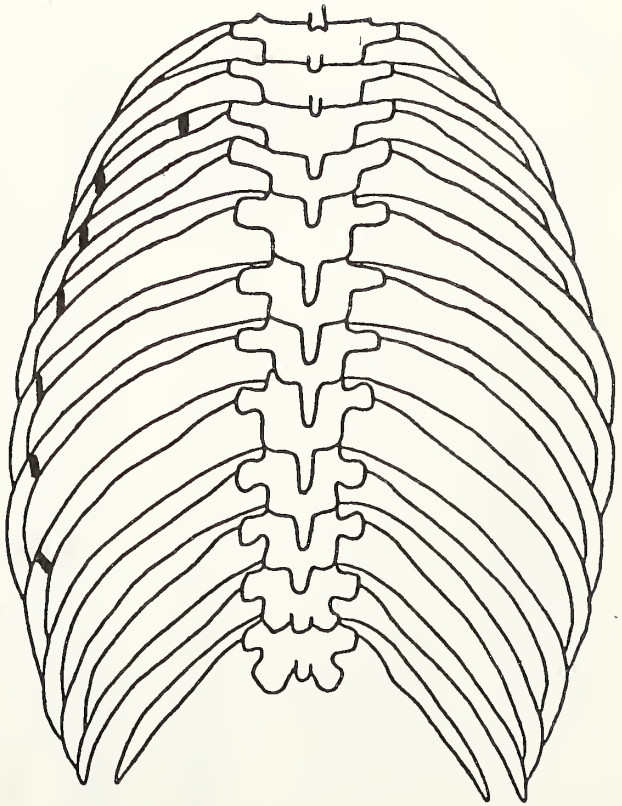
Run No. H 8o 17 DOT





Number of rib fractures 7

Run No. H 8215

a) Subject:
Male, 18 years, body weight 69 kg, body length 182 cm, (further anthropometric data s. incl.), cause of death: drown.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 23 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 7th and 8th rib left in the rear axillar line.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral Column:	No injuries.
Extremities:	Muscle hemorrhages at the out and rear side of the left upper arm.

e) AIS-Severity: Body surface 0, head 0, thorax 1, abdomen 0, pelvis 0, vertebral column 0, extremities 1, MAIS 1.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8215	6th	160	3,2	25,6
	7th	224	4,0	26,2

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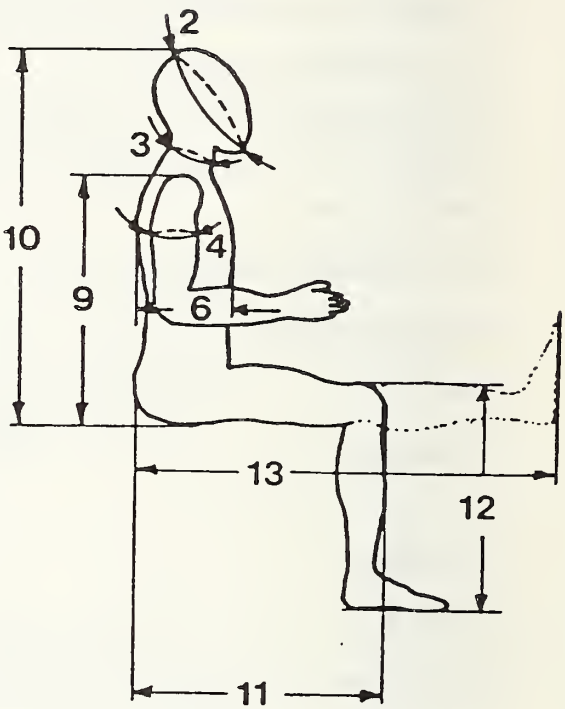
Run No. H 82 15 DOT

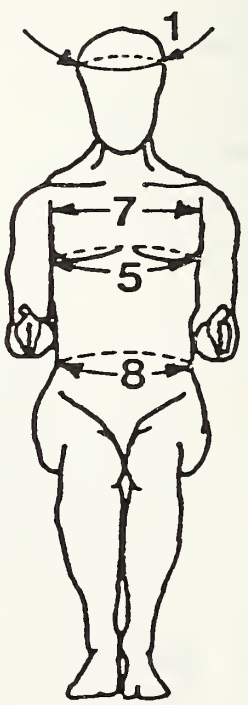
Anthropometrical Data

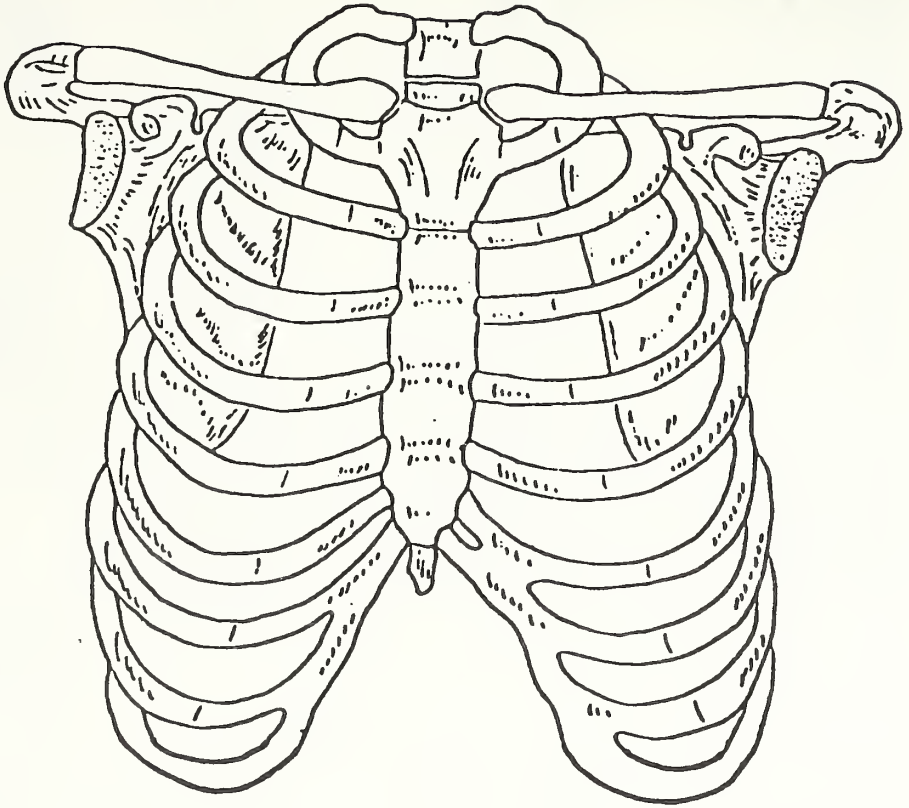
Body weight ..69.. kg

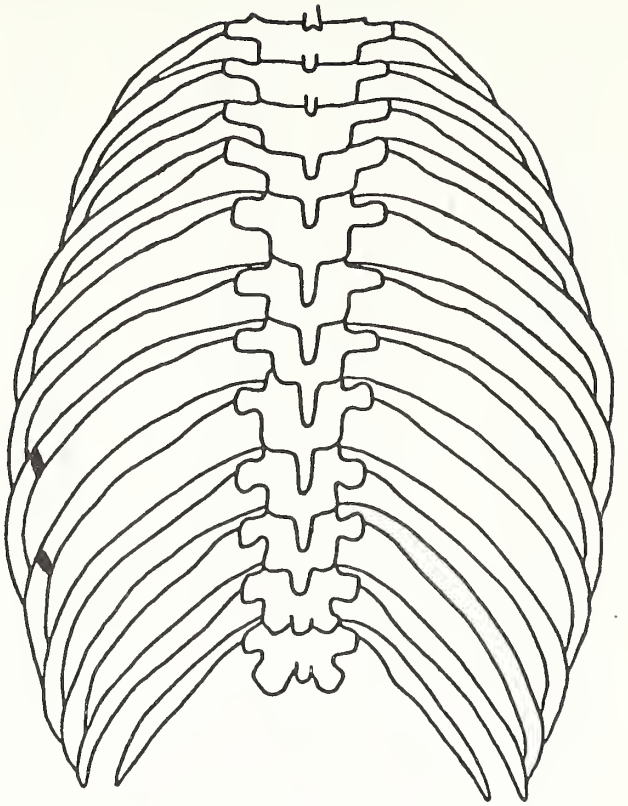
Body length ..182.. cm

1. Hat dimension ..54..cm
2. Head circumference..62..cm
3. Neck circumfer. ..38..cm
4. Upper arm circumfer. ..28..cm
5. Chest circumfer. ..85..cm
6. Chest height ..19..cm
7. Chest width ..29..cm
8. Abdomen circumfer. ..73..cm
9. Buttocks - shoulder ..71..cm
10. Seat height ..96..cm
11. Pelvis - knee ..64..cm
12. Sole of foot - knee ..56..cm
13. Pelvis - heal ..101..cm









Number of rib fractures ...2...

Run No. H 8218

a) Subject:
Female, 28 years, body weight 85 kg, body length 181 cm, (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 23 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of 2nd to 8th, 10th and 11th rib left in the front axillar line; transfixing of the pleura at the 4th rib left.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral column:	Hemorrhages in the vertebral discs C3/C4, C4/C5, C5/C6 and C6/C7 dorsal. Hemorrhage in the joint gap and loosening of the joint capsule of C1/C2.
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 3, abdomen 0, pelvis 0, vertebral column 1, extremities 0, MAIS 3.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8218	6th	112	2,2	22,2
	7th	184	4,9	21,6

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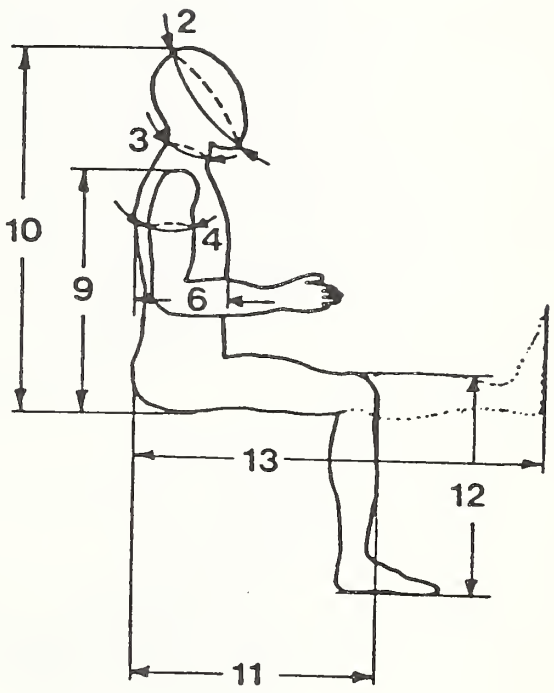
Run No. H 82 18 DOT .....

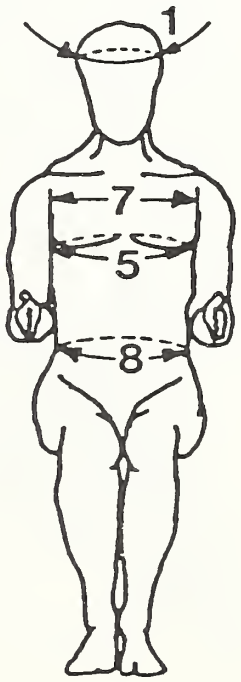
Anthropometrical Data

Body weight ..... 85 kg

Body length ..... 181 cm

1. Hat dimension ..... 58 cm
2. Head circumference ..... 68 cm
3. Neck circumfer. ..... 37 cm
4. Upper arm circumfer. ..... 30 cm
5. Chest circumfer. ..... 89 cm
6. Chest height ..... 24 cm
7. Chest width ..... 29 cm
8. Abdomen circumfer. ..... 92 cm
9. Buttocks - shoulder ..... 77 cm
10. Seat height ..... 100 cm
11. Pelvis - knee ..... 60 cm
12. Sole of foot - knee ..... 55 cm
13. Pelvis - heal ..... 105 cm





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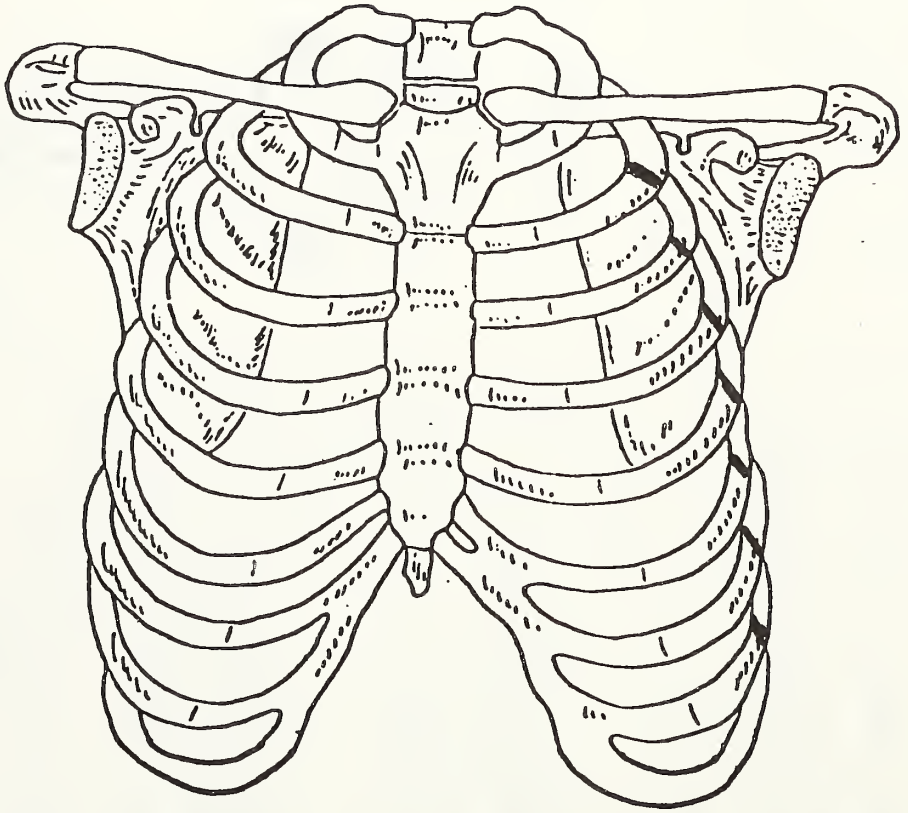
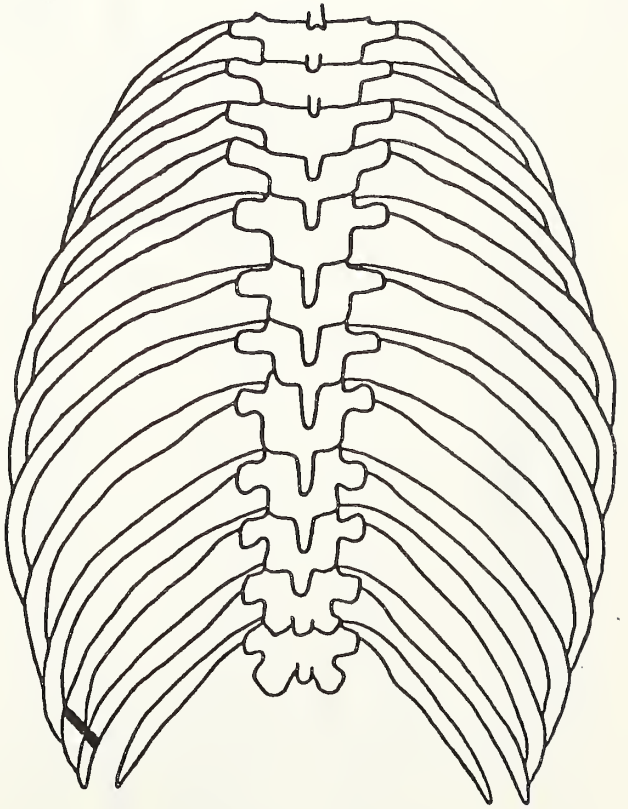
Run No. H 82 18 DOT .....





Number of rib fractures 9 .....

Run No. H 8219

a) Subject:
Female, 47 years, body weight 67 kg, body length 165 cm, (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 23 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 2d to the 8th rib left in the front axillar line. Transfixing of the pleura at the 4th rib left.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral column:	Hemorrhage in the ligamentum flavum between Th1 and Th2; small epidural hemorrhages of the spinal canal in the transition of the cervical to the thoracic vertebral column .
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 3, abdomen 0, pelvis 0, vertebral column 1, extremities 0, MAIS 3.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8219	6th	282	5,3	35,1
	7th	224	4,2	35,6

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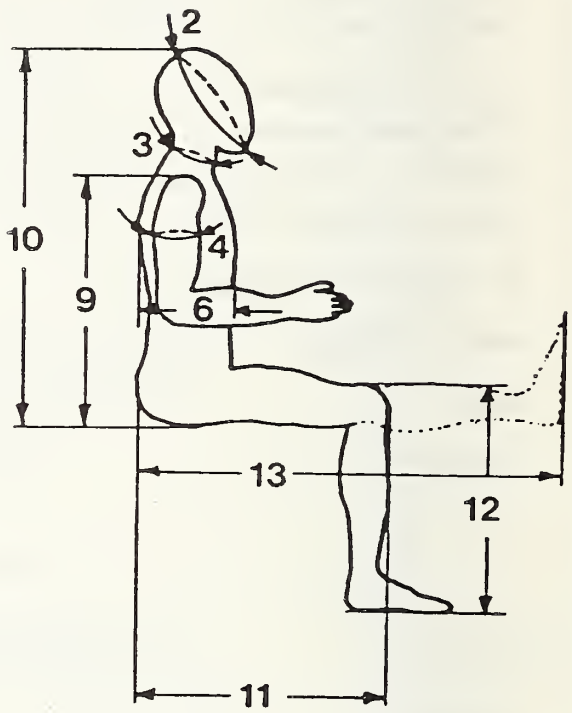
Run No. H 82 19 DOT

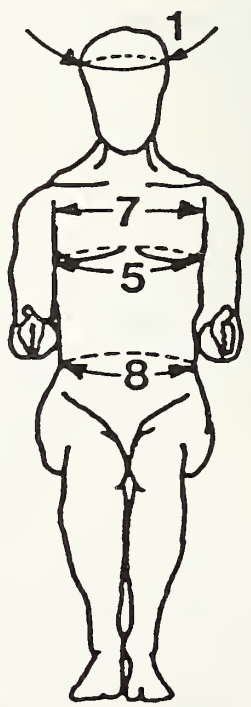
Anthropometrical Data

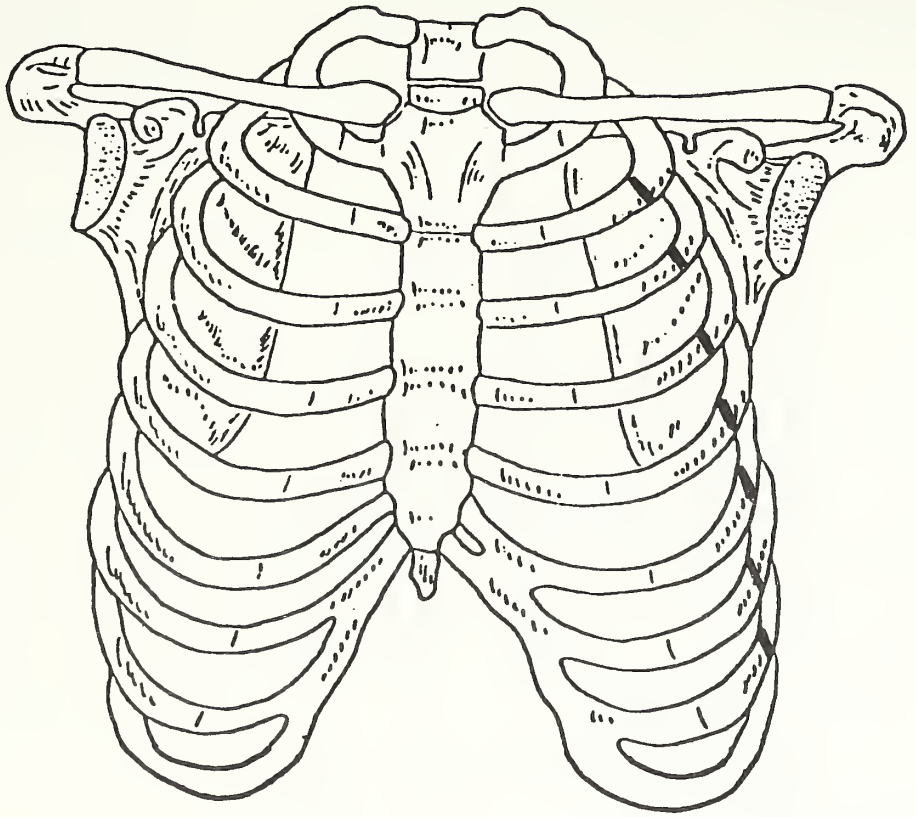
Body weight ..... 67 kg

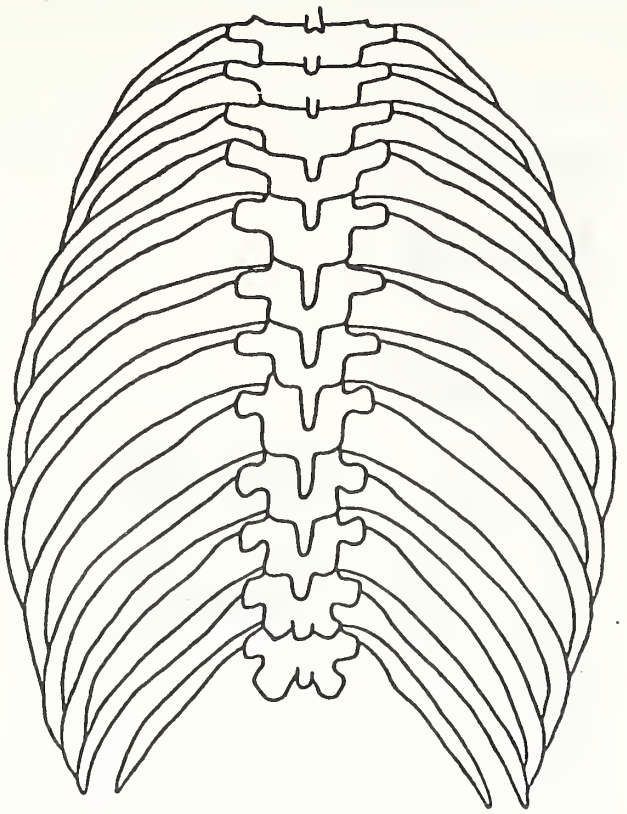
Body length ..... 165 cm

1. Hat dimension ..... 54 cm
2. Head circumference..... 61 cm
3. Neck circumfer. ..... 34 cm
4. Upper arm circumfer. ..... 26 cm
5. Chest circumfer. ..... 85 cm
6. Chest height ..... 21 cm
7. Chest width ..... 31 cm
8. Abdomen circumfer. ..... 79 cm
9. Buttocks - shoulder ..... 66 cm
10. Seat height ..... 88 cm
11. Pelvis - knee ..... 54 cm
12. Sole of foot - knee ..... 46 cm
13. Pelvis - heal ..... 90 cm









Number of rib fractures 7

APPENDIX II

LATERAL IMPACT CADAVER TESTS INTO A RIGID WALL IMPACT VELOCITY : 32 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8024	male	24	65	176	56	64	40	29	85
H 8102	male	57	65	165	55	63	43	26	90
H 8104	male	56	80	165	54	66	40	29	95
H 8106	male	37	82	170	59	66	48	31	100
H 8125	male	38	65	177	57	67	42	29	86
H 8202	male	47	68	165	53	63	39	30	98
H 8214	female	22	61	178	55	63	34	22	83
H 8216	male	21	50	187	58	66	37	25	84
H 8220	male	41	73	180	55	66	39	27	89
9	M 8 F 1	38.1	67.7	173.7	55.8	64.9	40.2	27.6	90

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8024	22	29	75	65	90	62	53	93
H 8102	24	32	82	69	94	37	49	76
H 8104	25	32	93	71	92	55	46	92
H 8106	25	34	90	63	86	40	45	79
H 8125	21	28	76	70	96	52	62	102
H 8202	23	32	85	68	90	56	48	94
H 8214	20	29	78	68	94	62	54	102
H 8216	20	27	71	73	100	60	56	102
H 8220	22	32	76	70	94	60	54	104
9	22.4	30.6	80.67	68.6	92.9	53.8	51.9	93.78

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8024	rig.wall	33	0	0	0	0	0	0	0
H 8102	rig.wall	33	28	23	8	15	5	5	0
H 8104	rig.wall	32	35	25	6	19	11	4	7
H 8106	rig.wall	32	16	16	8	8	0	0	0
H 8125	rig.wall	32	15	15	7	8	0	0	0
H 8202	rig.wall	32	20	20	11	9	0	0	0
H 8214	rig.wall	32	18	18	6	12	0	0	0
H 8216	rig.wall	31	11	11	3	8	0	0	0
H 8220	rig.wall	31	20	17	9	8	3	1	2
9	rig.wall	32	18	16	8.4	9.7	2.1	1.1	1

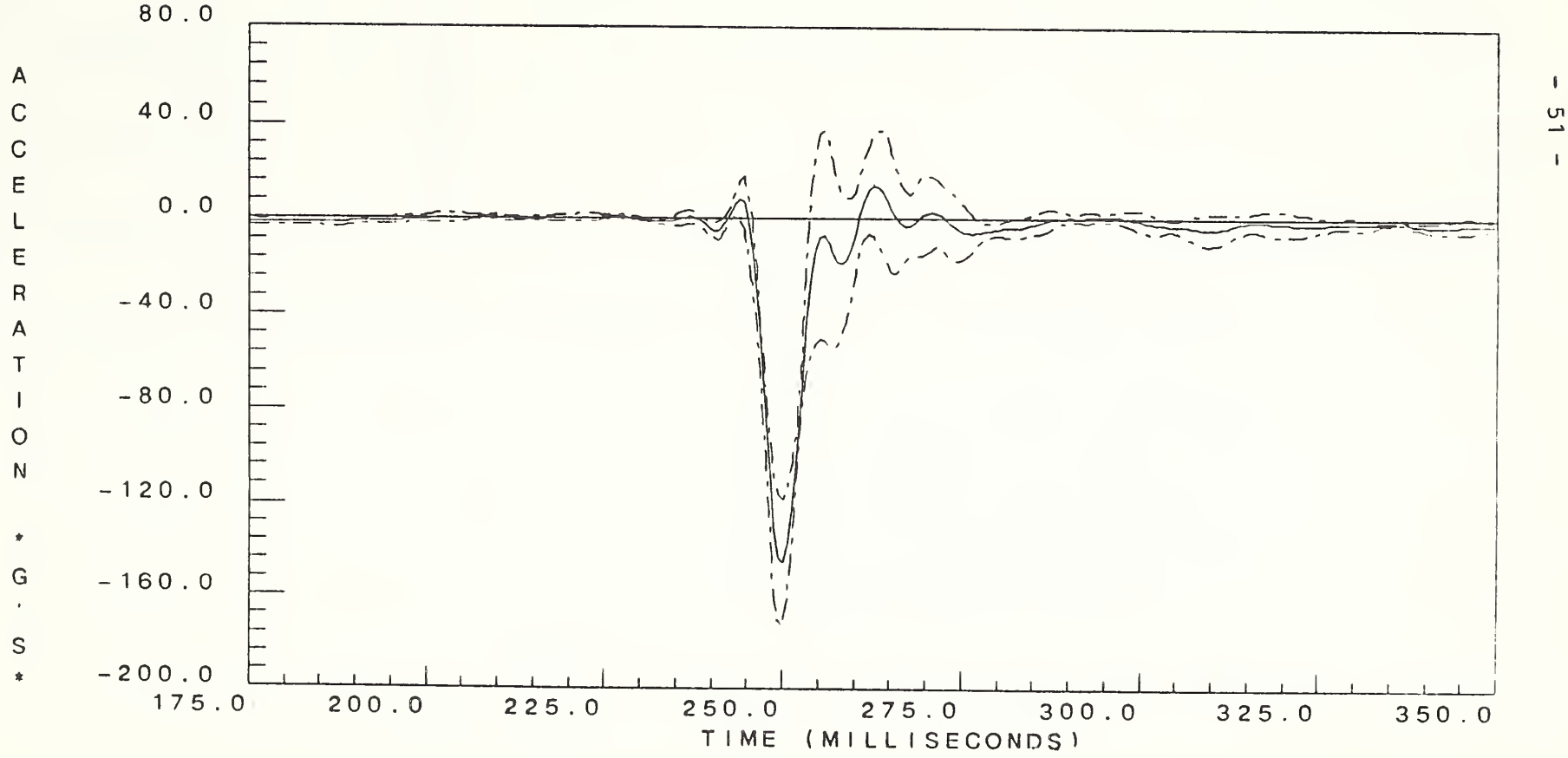
AIS - SEVERITY

Run No	Body Surface	Head	Thorax	Abdomen	Pelvis	Spine	Extrem.	MAIS
H 8024	0	0	0	0	0	0	0	0
H 8102	0	4	4	4	0	2	0	4
H 8104	0	0	4	4	0	2	0	4
H 8106	0	0	3	0	0	1	1	3
H 8125	1	0	4	5	0	2	0	5
H 8202	1	0	4	5	0	2	0	5
H 8214	0	0	4	5	3	1	1	5
H 8216	0	0	3	0	0	1	2	3
H 8220	0	0	4	5	2	0	1	5
9	.2	.4	3	3	.6	1	.6	4

	6th RIB			7th RIB		
Run No	max. Force [N]	max. Defl. [mm]	Cross section [mm2]	max. Force [N]	max. Defl. [mm]	Cross section [mm2]
H 8024	274	5.0	28.5	269	3.4	36.7
H 8102	48	.8	24	111	2.8	26
H 8104	154	3.2	23	123	3.7	24
H 8106	205	3.4	33	334	3.8	44
H 8125	255	4.2	31	266	3.8	39
H 8202	380	4.6	53	188	4.5	38
H 8214	354	7.5	34.1	361	5.5	35.4
H 8216	280	5.0	28.0	318	7.9	29.9
H 8220	216	3.8	25.9	152	3.2	22.1
9	240.7	4.17	31.17	235.8	4.29	32.79

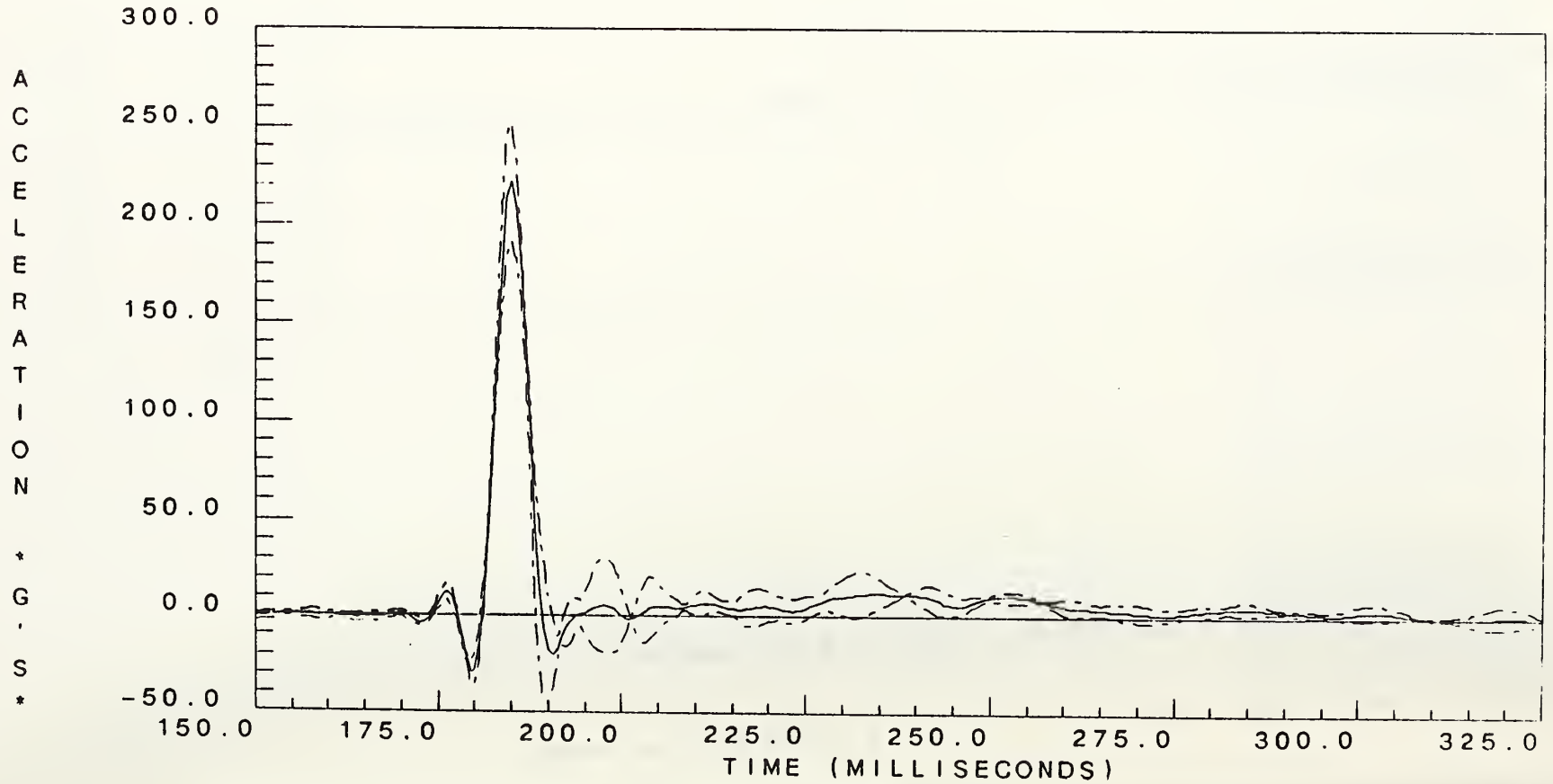
Mean Response with +/- 1 St. Dev. Corridor

20 MPH Rigid Wall, Upper Rib (Y)



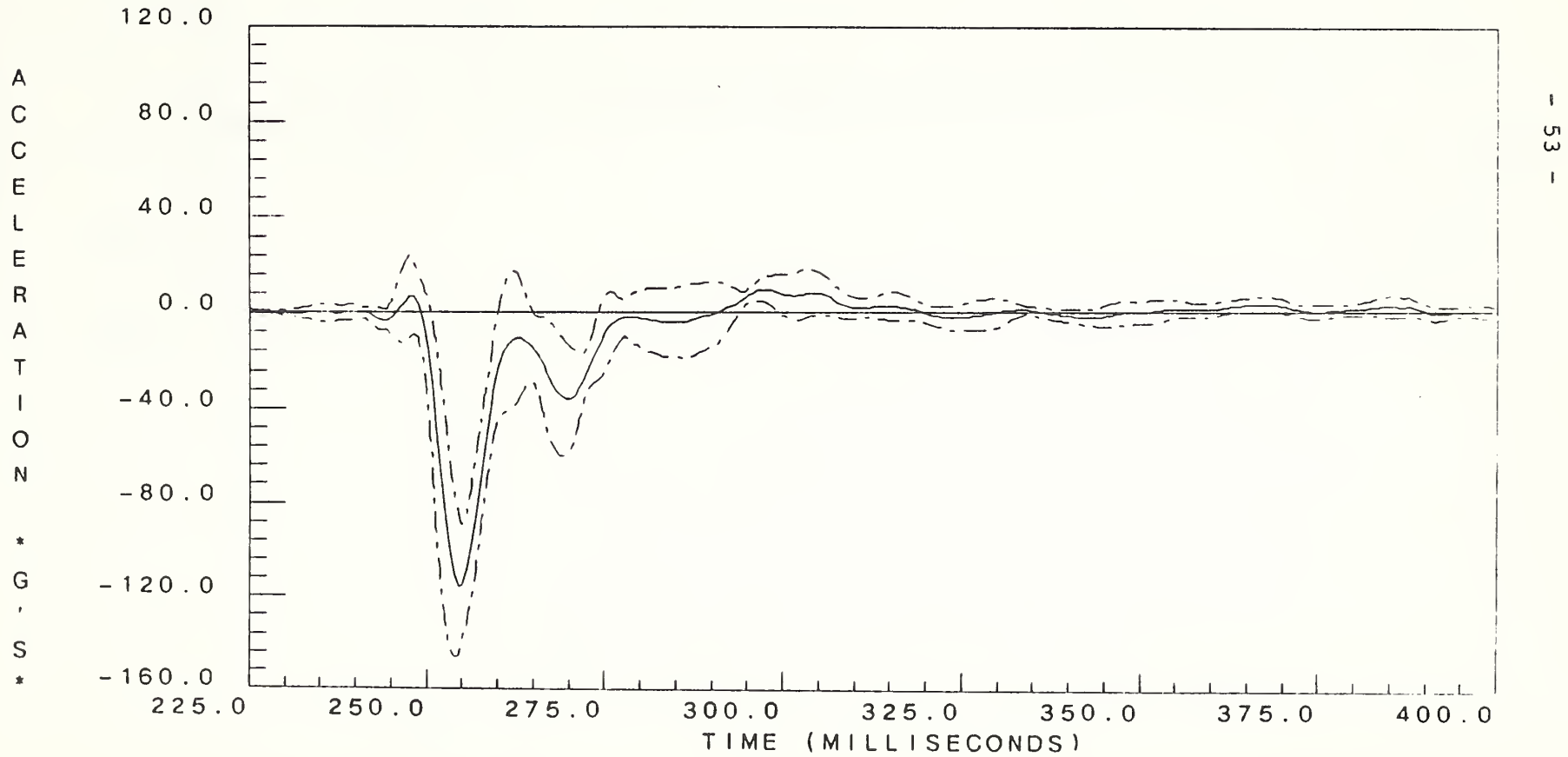
Mean Response with +/- 1 St. Dev. Corridor

20 MPH Rigid Wall, Lower Rib (Y)



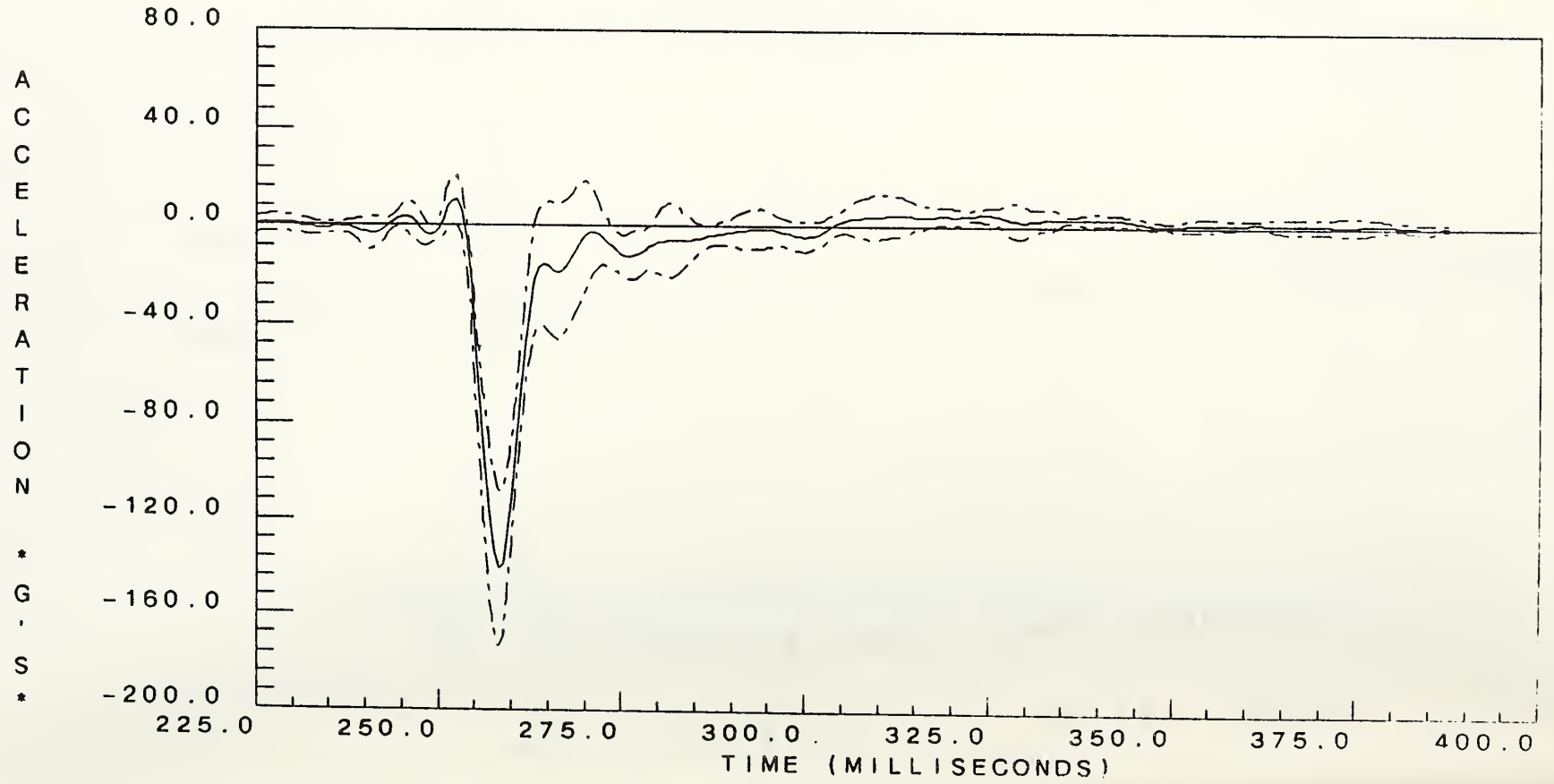
Mean Response with +/- 1 St. Dev. Corridor

20 MPH Rigid Wall, Upper Spine (Y)



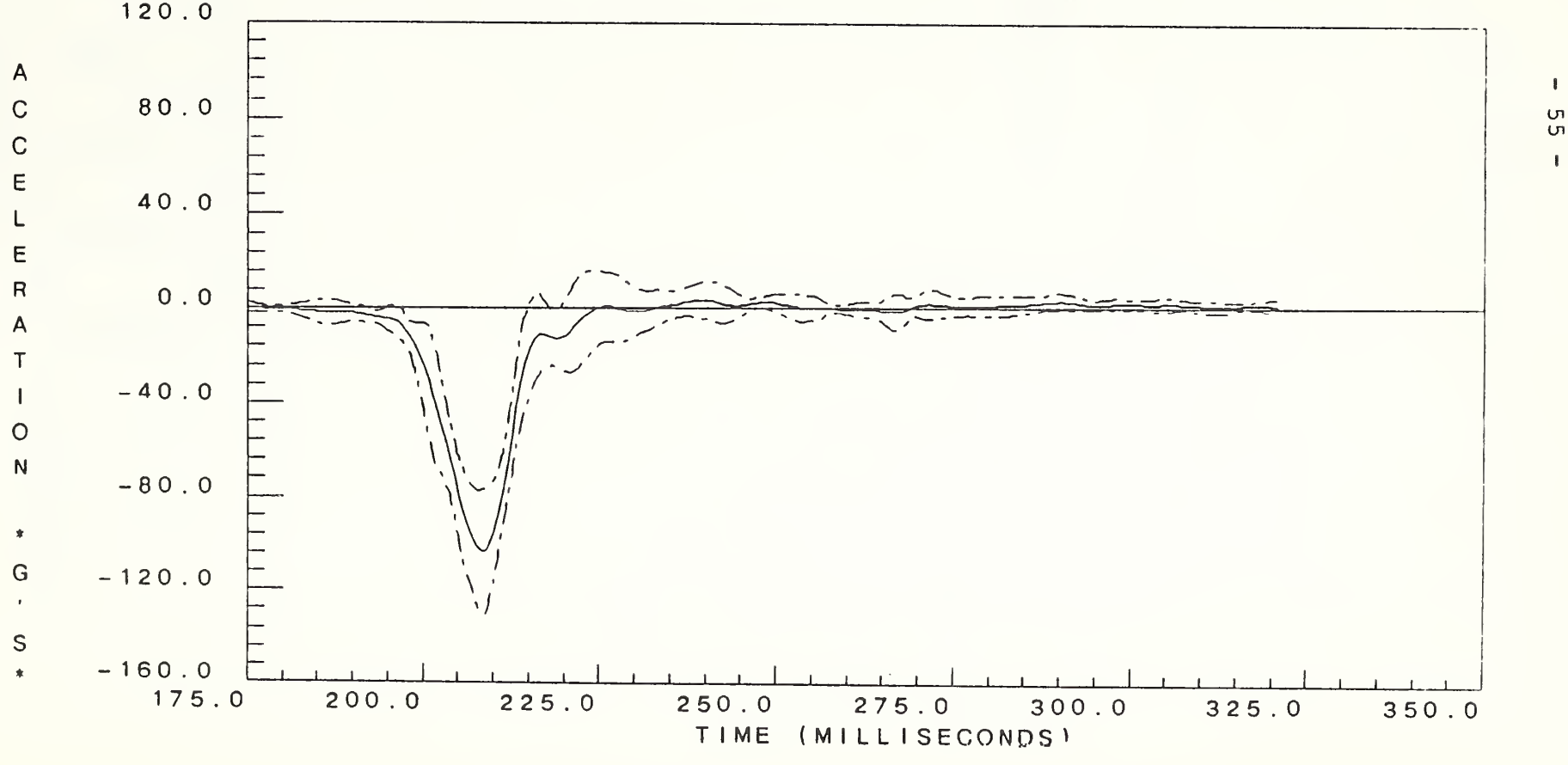
Mean Response with +/- 1 St. Dev. Corridor

20 MPH Rigid Wall, Lower Spine (Y)



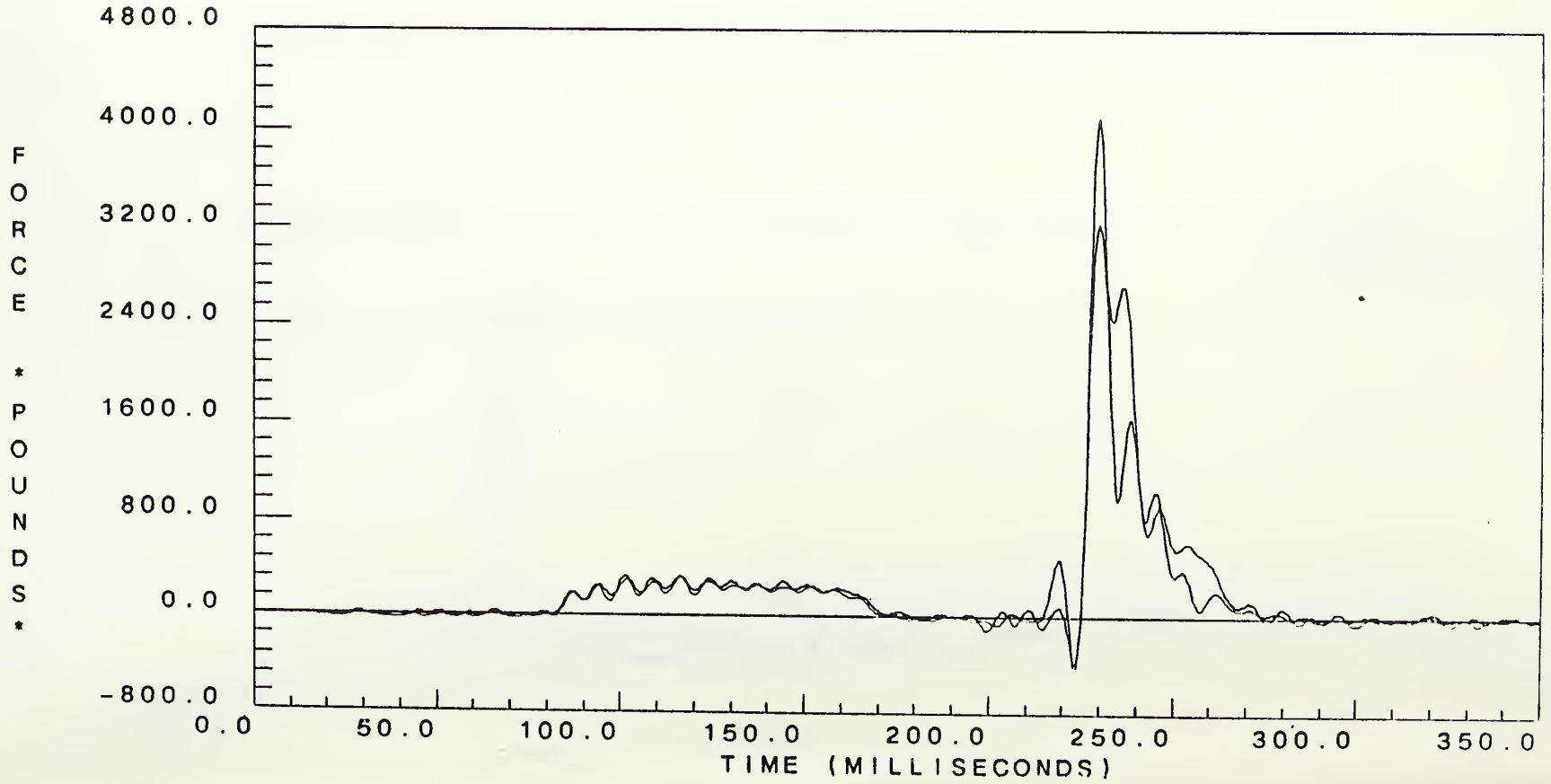
Mean Response with +/- 1 St. Dev. Corridor

20 MPH Rigid Wall, Pelvis Acc. (Y)



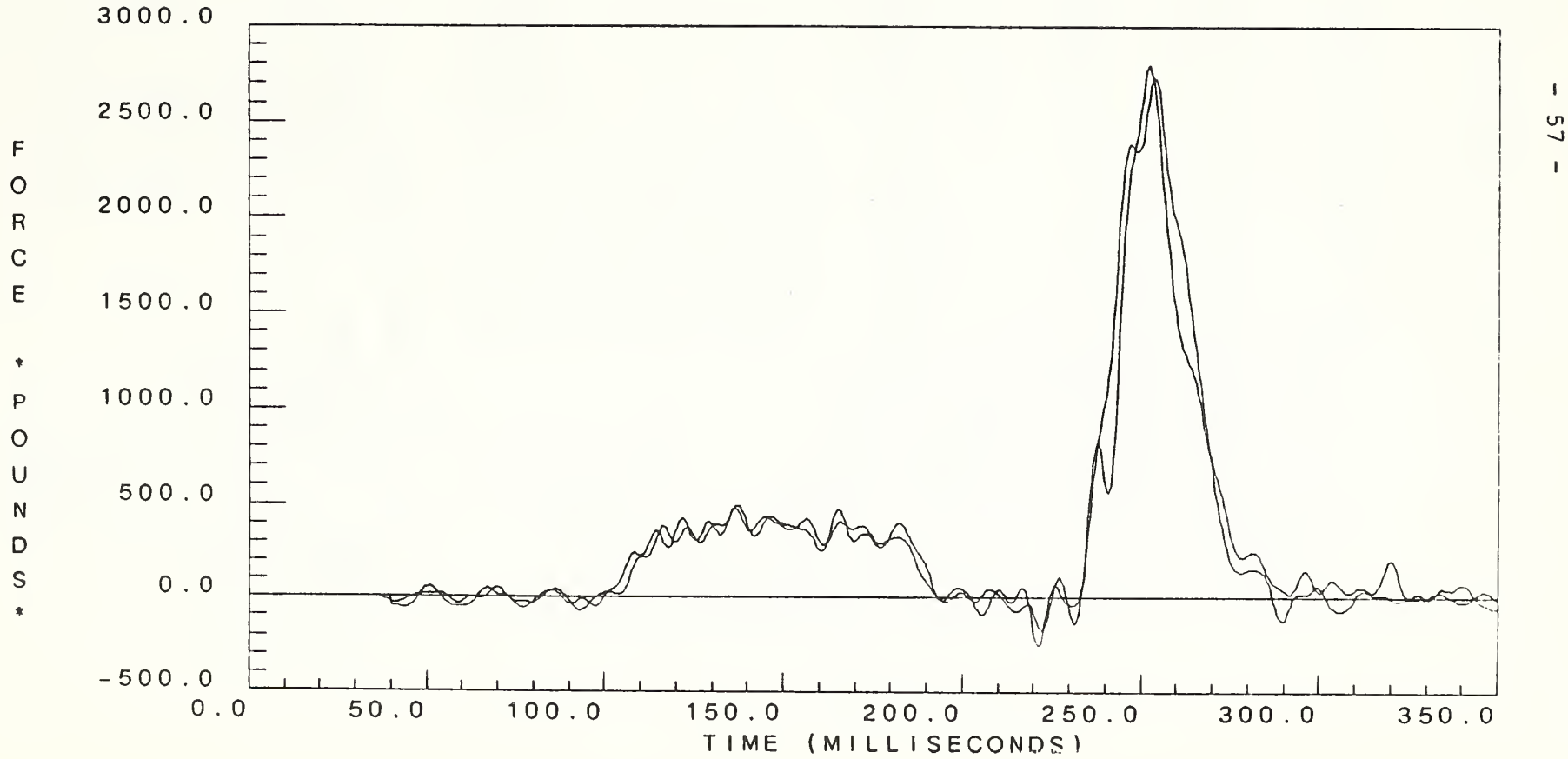
Side Impact Loads

20 MPH Rigid Wall, Pelvis (Y)



Side Impact

20 MPH Rigid Wall, Shoulder (Y)



Run No. H 80 024

a) Subject:
Male, 24 years, body weight 65 kg, body length 176 cm (further anthropometric data s. incl.), cause of death: drown.

b) Test conditions:
Lateral collision - rigid wall - impact velocity 33 km/h.

c) Instrumentation:
Sled Deceleration, 9 accelerometer head, 12 accelerometer thorax, 3 accelerometer pelvis, lung pressure.

d) Medical findings:

Body Surface:	No injuries
Head:	No injuries
Thorax:	No injuries
Abdomen:	No injuries
Vertebral Column:	No injuries
Extremities:	No injuries

e) Severity Degree: AIS-Head 0, AIS-Thorax-0, AIS-Abdomen 0, AIS-Vertebral Column 0, AIS-Extremities 0, MAIS 0

BENDING TESTS

Run No. H 80 024	Max. Force (N)	Max. Deflection (mm)	Cross Section (mm^2)
6th rib	274	5,0	28,5
7th rib	269	3,4	36,7

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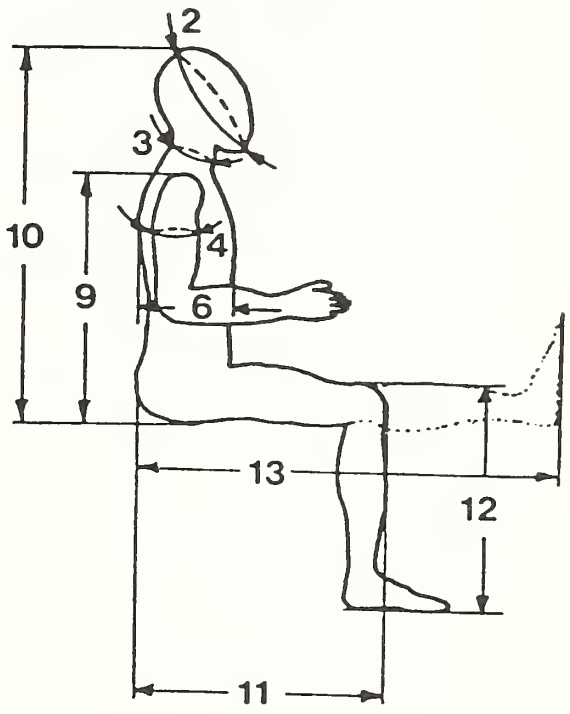
Run No. H 80 024

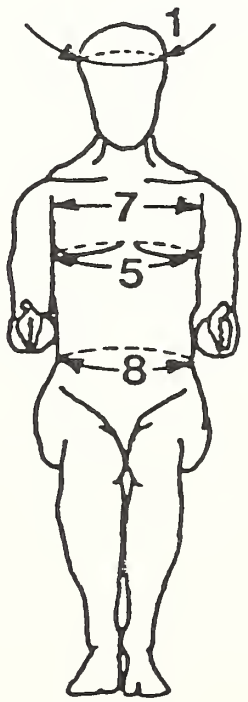
Anthropometrical Data

Body weight ..... 65 kg

Body length ..... 176 cm

1. Hat dimension ..... 56 ...cm
2. Head circumference..... 64 ...cm
3. Neck circumfer. ..... 40 ...cm
4. Upper arm circumfer. ..... 29 ...cm
5. Chest circumfer. ..... 85 ...cm
6. Chest height ..... 22 ...cm
7. Chest width ..... 29 ...cm
8. Abdomen circumfer. ..... 75 ...cm
9. Buttocks - shoulder ..... 65 ...cm
10. Seat height ..... 90 ...cm
11. Pelvis - knee ..... 62 ...cm
12. Sole of foot - knee ..... 53 ...cm
13. Pelvis - heal ..... 93 ...cm





Run No. H 81 002

a) Subject:
Male, 57 years, body weight 65 kg, body length 165 cm (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 33 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	Le Fort III fracture.
Thorax:	Fracture of the 1st, 2nd and 5th rib left, 3 times; fracture of the 3th and 4th rib left, 4 times; fracture of the 6th and 7th rib left, 2 times; fracture of the 8th and 9th rib left. Fracture of the 2nd, 3th, 4th, 5th and 6th rib right. Multiple fractures of the left scapula.
Abdomen:	Multiple spleen ruptures.
Vertebral Column:	Small hemorrhage in the deep muscular layer between occiput and C1 left. Fracture of the processus transversus of the C1, C2, C4, C5 and C6 left. Hemorrhage in the vertebral disc C4/C5. Hemorrhage in the interspinal space between Th11 and Th12.

Extremities: No injuries.

e) Severity Degree: AIS-head 4, AIS-thorax 4, AIS-abdomen 4, AIS-vertebral column 2, AIS-extremities 0, MAIS 4.

BENDING TESTS

Run No. H 81 002

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	48	0,8	24
7th rib	111	2,8	26

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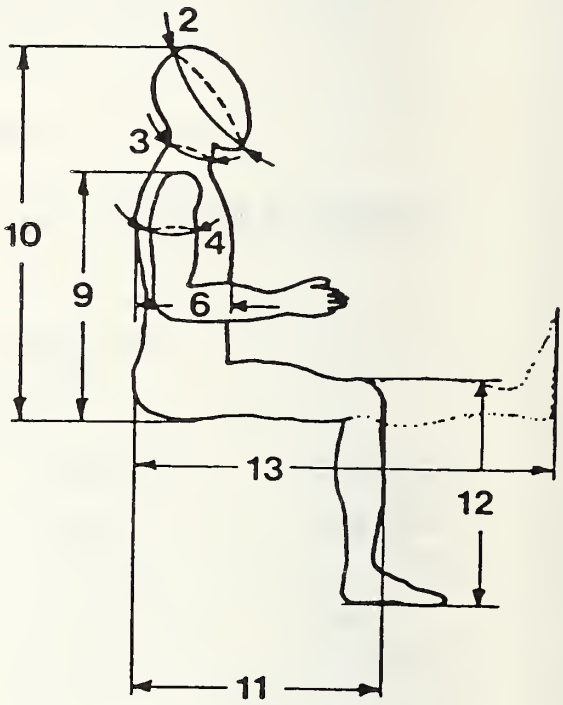
H 81 oo2
Run No. .....

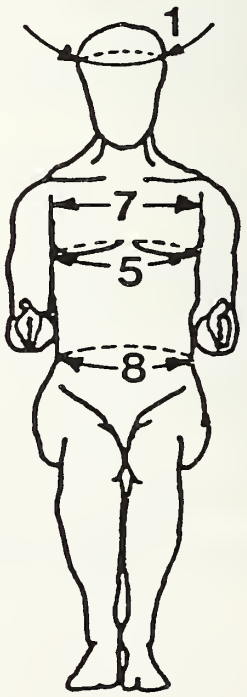
Anthropometrical Data

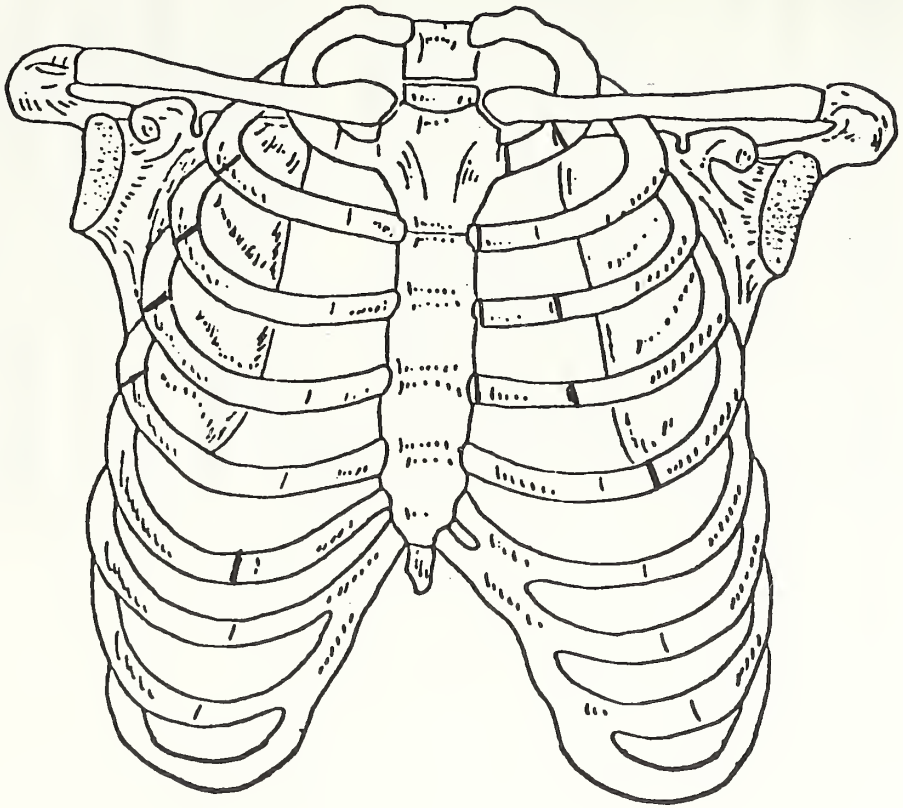
Body weight ..... 65 kg

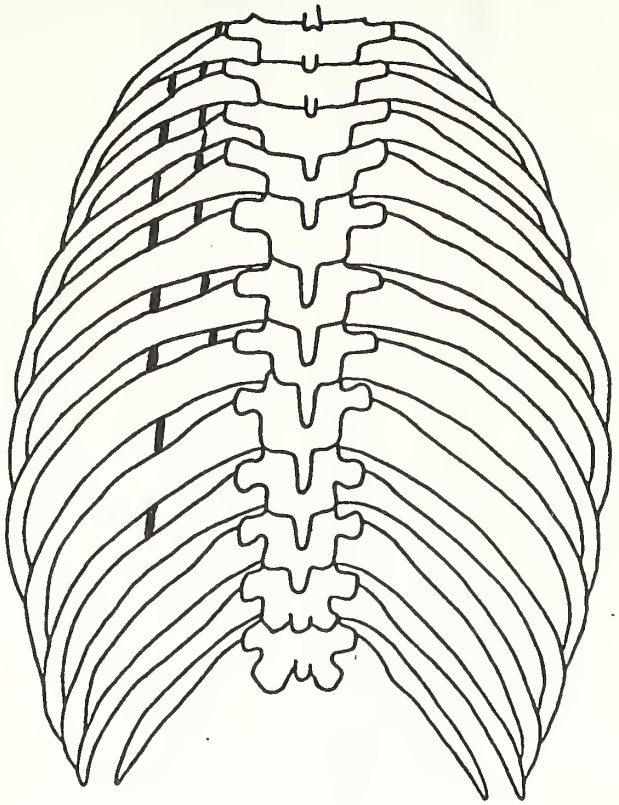
Body length ..... 165 cm

1. Hat dimension .....55.....cm
2. Head circumference.....63.....cm
3. Neck circumfer. .....43.....cm
4. Upper arm circumfer. .....26.....cm
5. Chest circumfer. .....9o.....cm
6. Chest height .....24.....cm
7. Chest width .....32.....cm
8. Abdomen circumfer. .....82.....cm
9. Buttocks - shoulder .....69.....cm
10. Seat height .....94.....cm
11. Pelvis - knee .....37.....cm
12. Sole of foot - knee .....49.....cm
13. Pelvis - heal .....76.....cm









Number of rib fractures 28

Run No. H 81 004

a) Subject:
Male, 56 years, body weight 80 kg, body length 165 cm (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions:
Lateral collision - rigid wall - impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Mascular bleeding in the scapula area left. Rib fractures left: 1st - 10th rib in the paravertebral region, 2nd - 10th rib in the rear axillar line, 2nd - 4th rib in the mamillar line, 2nd - 4th rib in the cartilage - bone transition. Rib fractures right: 5th - 7th rib in the sternum area, 7th rib in the front axillar line, 1st rib in the inner scapular line, two times; 2nd - 6th rib in the rear axillar line.
Abdomen:	Rupture of the spleen.
Vertebral Column:	Hemorrhage of the superficial and medium mascular layer between Th 10 and Th12. Rupture and hemorrhage in the vertebral disc C5/C6. Hemorrhage in the vertebral disc C3/C4. Hemorrhage in the inter-spinal space between Th2 and Th3. Rupture of the ligamentum flavum

between C7 and Th1. Hemorrhages and expansion of the joint distances from C3 - C6 right. Hemorrhage of the foramen intervertebral between C6 and C7. Hemorrhage in the ligamentum flavum between C5 and C6.

Extremities: No injuries.

e) Severity degree: AIS-head 0, AIS-thorax 4, AIS-abdomen 4, AIS-vertebral column 2, AIS-extremities 0, MAIS 4.

BENDING TESTS

Run No. H 81 004*

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
8th rib	154	3,2	23
9th rib	123	3,7	24

* 6th and 7th rib was broken, therefore bending tests of the 8th and 9th rib.

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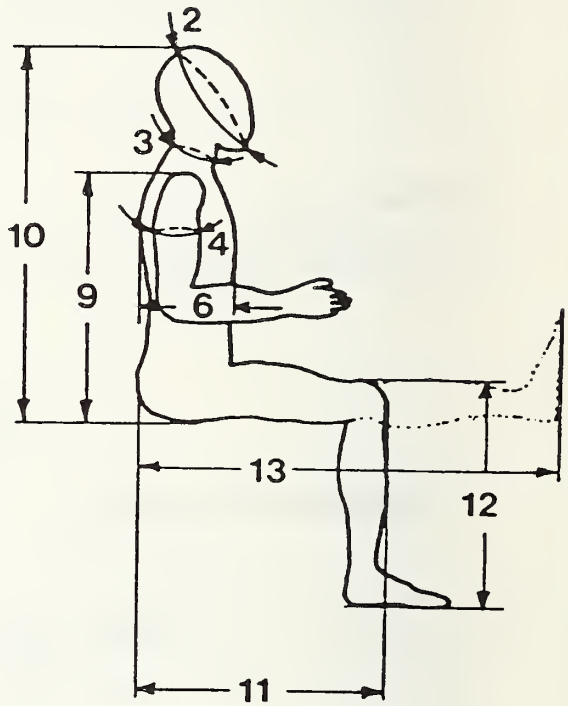
Run No. H 81 oo4

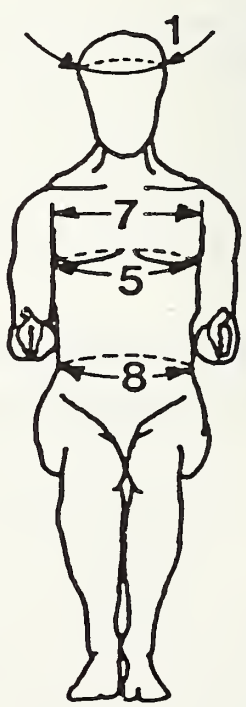
Anthropometrical Data

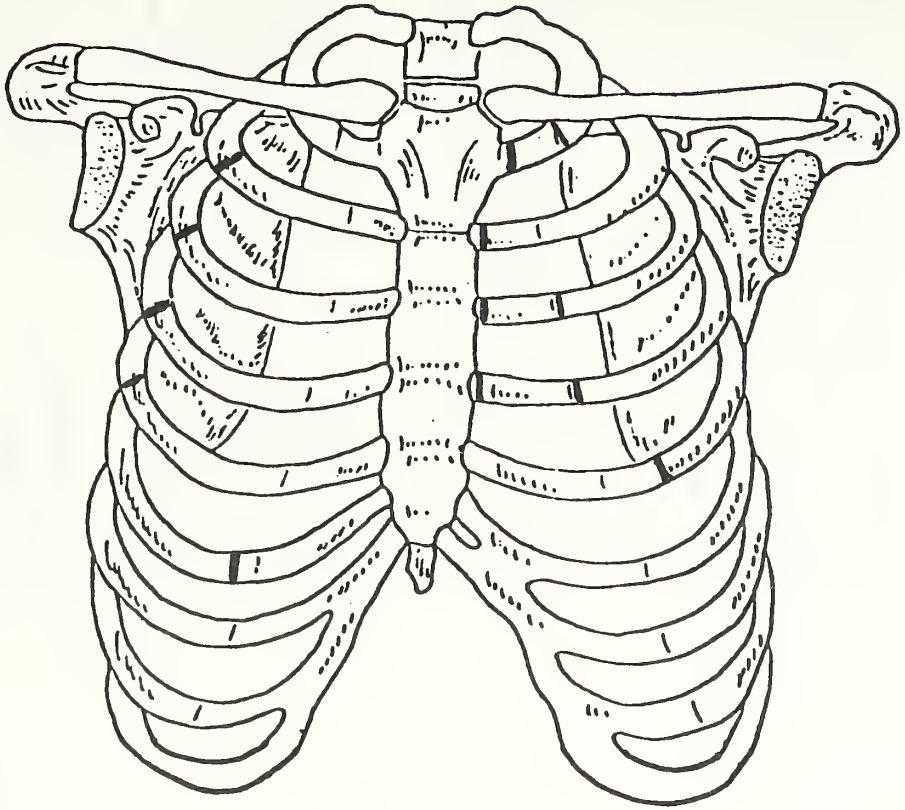
Body weight ...80 kg

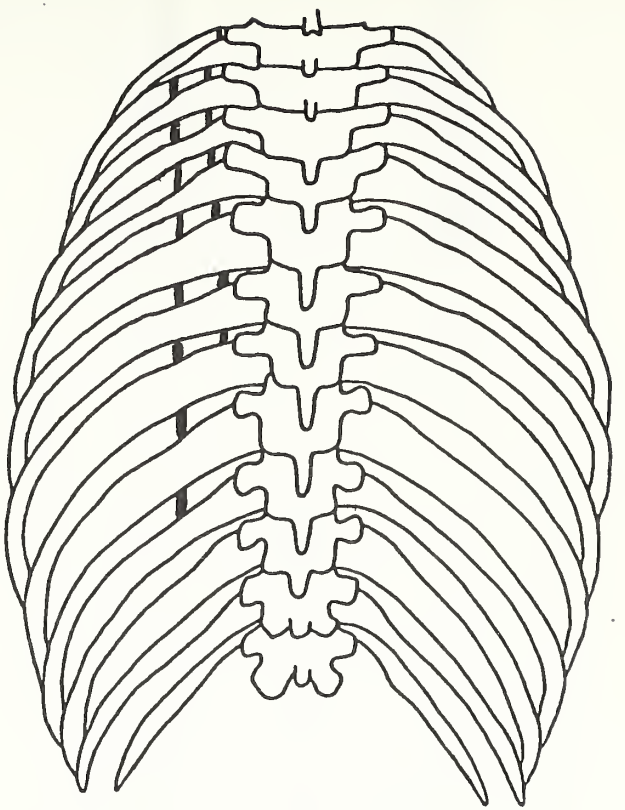
Body length ...165 cm

1. Hat dimension .....54.....cm
2. Head circumference.....66.....cm
3. Neck circumfer. .....40.....cm
4. Upper arm circumfer. .....29.....cm
5. Chest circumfer. .....95.....cm
6. Chest height .....25.....cm
7. Chest width .....32.....cm
8. Abdomen circumfer. .....93.....cm
9. Buttocks - shoulder .....71.....cm
10. Seat height .....92.....cm
11. Pelvis - knee .....55.....cm
12. Sole of foot - knee .....46.....cm
13. Pelvis - heal .....92.....cm









Number of rib fractures ..28..

Run No. 81 006

a) Subject:

Male, 37 years, body weight: 82 kg, body length: 170 cm (further anthropometric data s. incl.), cause of death: cardial infarct.

b) Test conditions:

Lateral collision, rigid wall, impact velocity 32 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 1st, 2nd, 3rd, and 8th rib left in the paravertebral region, of the 4th, 5th, 6th and 7th rib left in the medium scapular line. Fracture of the 1st and 2nd rib left in the cartilage-bone transition; fracture of the 3rd rib left, 3 cm from the sternum and in the frontal axillar line. Fracture of the 4th - 7th rib left in the frontal axillar line.
Abdomen:	No injuries.
Vertebral Column:	Hemorrhage in the vertebral disc C3/C4. Hemorrhage in the vertebral disc C5/C6 with laceration and part loosening of the vertebral disc from the upper vertebral surface of the vertebral body C6.
Extremities:	Skin abrasion at the outside of the left elbow.
e) Severity Degree:	AIS-head 0, AIS-thorax 3, AIS-abdomen 0, AIS-vertebral column 1, AIS-extremities 1, MAIS 3.

BENDING TESTS

Run No. H 81 006

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	205	3,4	33
7th rib	334	3,8	44

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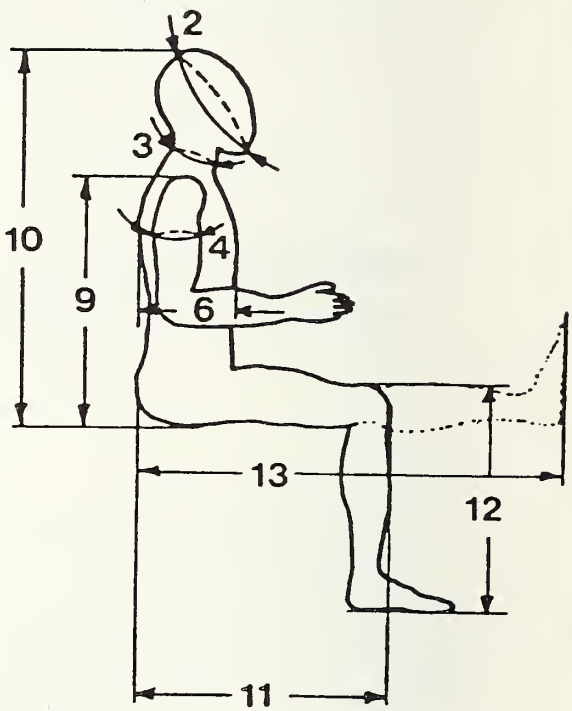
Run No. H 81 006

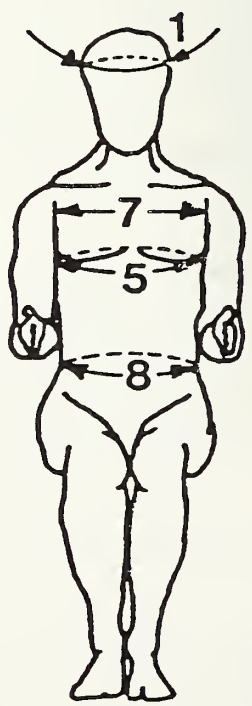
Anthropometrical Data

Body weight ...82 kg

Body length ...170 cm

1. Hat dimension .....59.....cm
2. Head circumference.....66.....cm
3. Neck circumfer. .....48.....cm
4. Upper arm circumfer. .....31.....cm
5. Chest circumfer. .....100.....cm
6. Chest height .....25.....cm
7. Chest width .....34.....cm
8. Abdomen circumfer. .....90.....cm
9. Buttocks - shoulder .....63.....cm
10. Seat height .....86.....cm
11. Pelvis - knee .....40.....cm
12. Sole of foot - knee .....45.....cm
13. Pelvis - heal .....79.....cm





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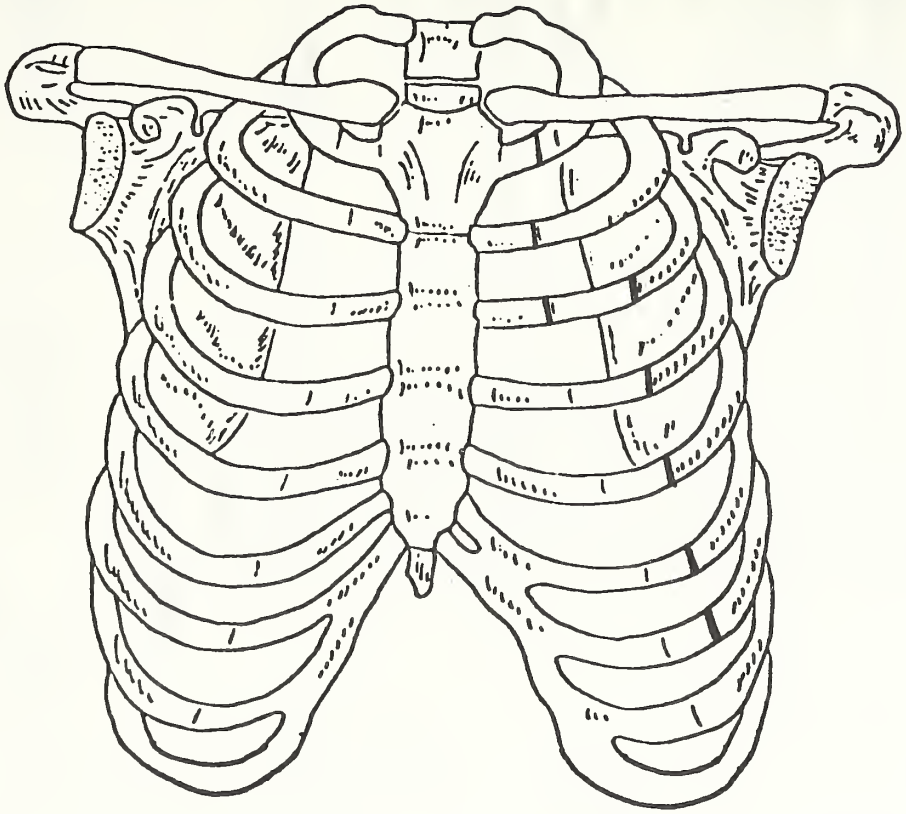
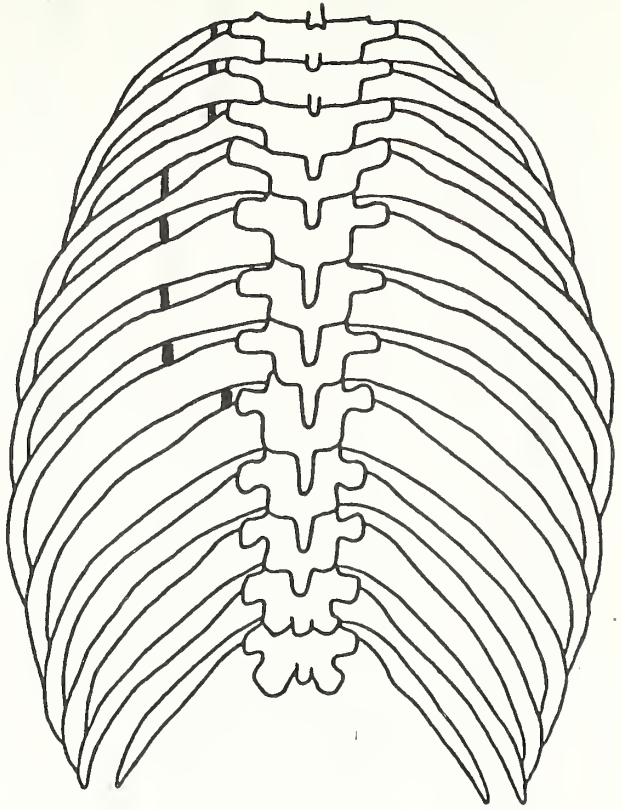
Run No. H 81 06 DOT





Number of rib fractures 16

Run No. H 81025

a) Subject:
Male, 38 years, body weight 65 kg, body length 177 cm, (further anthropometric data s. incl.), cause of death suffocation.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	Skin abrasion over the left hand.
Head:	No injuries.
Thorax:	Rib fractures left side: 1st to 8th rib in the paravertebral region. 3th to 9th rib in the front axillar line, the ribs 3 to 5 with transfixing. Laceration of the lung caused rib transfixing (Incl.).
Abdomen:	Rupture of the left kidney.
Vertebral column:	Hemorrhage in the deep muscle layer between Th6 and Th9 left. Intense hemorrhage at the backside of the dorsal spinal cord dura. Hemorrhage in the vertebral disc L2/L3.
Extremities:	No injuries.
e) AIS Severity:	Body surface 1, head 0, thorax 4, abdomen 5, vertebral column 2, extremities 0, MAIS 5.

BENDING TESTS

Run No. H 81025	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	255	4,2	31
7th rib	266	3,8	39

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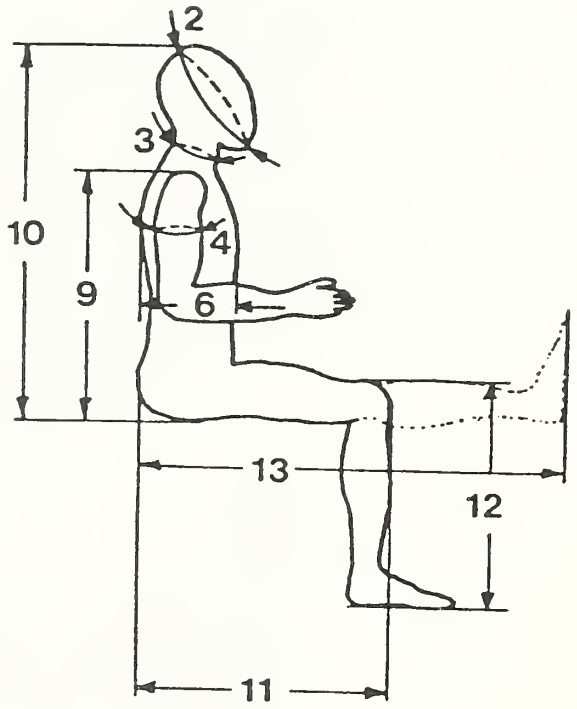
Run No. H 81 o25

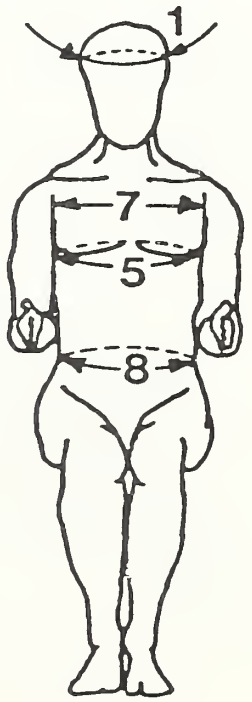
Anthropometrical Data

Body weight ....65 kg

Body length ....177 cm

1. Hat dimension .....57.....cm
2. Head circumference.....67.....cm
3. Neck circumfer. .....42.....cm
4. Upper arm circumfer. .....29.....cm
5. Chest circumfer. .....86.....cm
6. Chest height .....21.....cm
7. Chest width .....28.....cm
8. Abdomen circumfer. .....76.....cm
9. Buttocks - shoulder .....7o.....cm
10. Seat height .....96.....cm
11. Pelvis - knee .....52.....cm
12. Sole of foot - knee .....62.....cm
13. Pelvis - heal .....1o2.....cm





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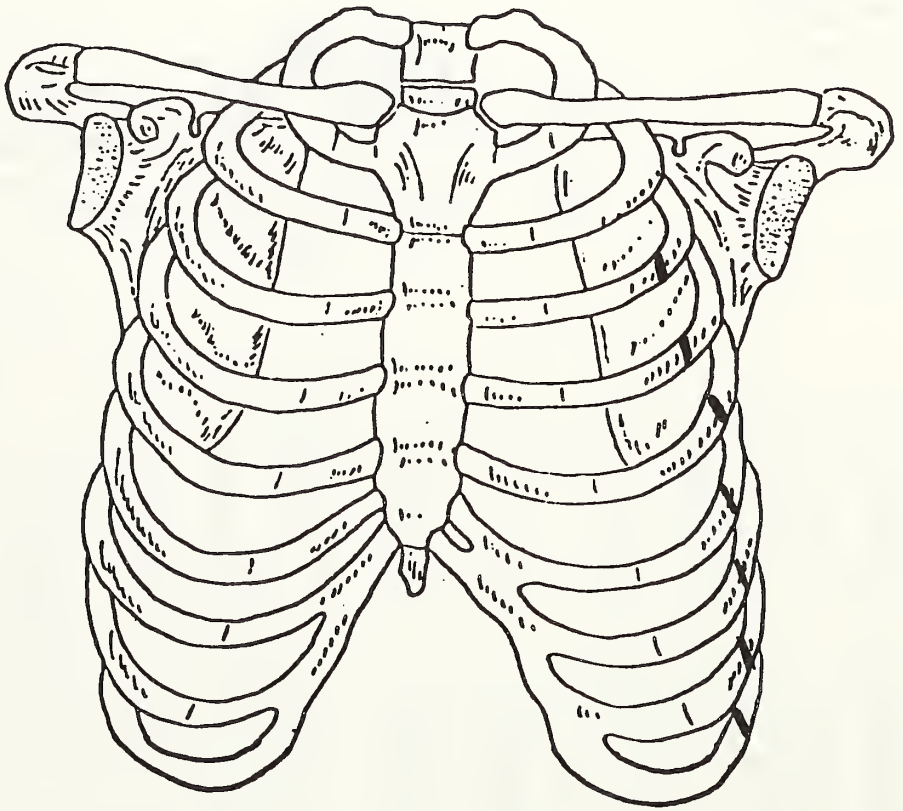
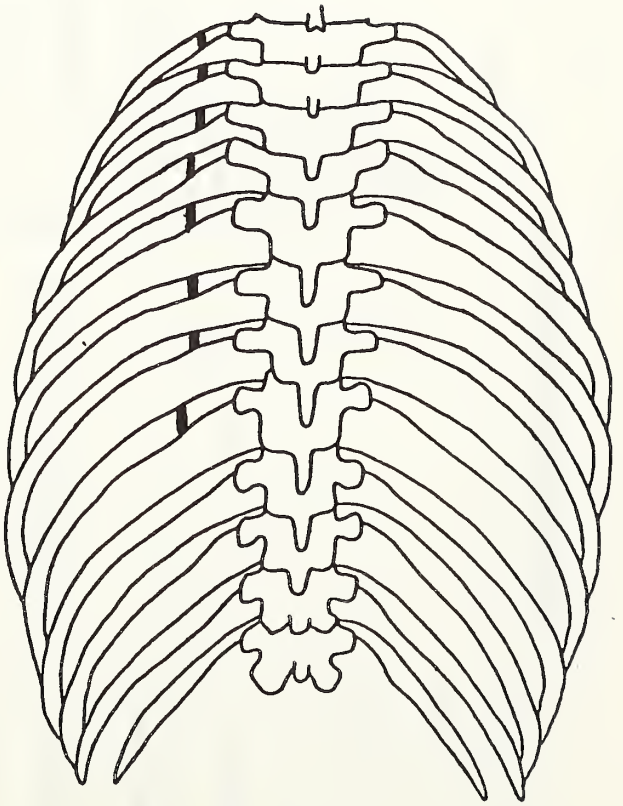
Run No. H 81 25 DOT





Number of rib fractures 15

Run No. H 82 002

a) Subject:
Male, 47 years, body weight 68 kg, body length 165 cm, (further anthropometric data s. incl.), cause of death: heart failure.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	Contusion of the skin over the left elbow.
Head:	No injuries.
Thorax:	Fracture of the 2d to 4th rib left in the cartilage-bone transition. Fracture of the 1st to 8th rib left in the front axillar line, the ribs of the 3d to 7th with transfixing of the pleura. Fracture of the 1st to 9th rib left in the para-vertebral region, the ribs 6 and 7, with transfixing of the pleura; muscle bleeding under the left scapula.
Abdomen:	Rupture of the spleen, of the liver, and double rupture of the left kidney.
Vertebral Column:	Laceration and hemorrhage of the vertebral discs C2 and C4 dorsal; hemorrhage of the vertebral disc C7 central, hemorrhage of the vertebral discs C3 and C5. Laceration of the ligamentum flavum C7 and Th1. Hemorrhage of the joint C4 and C7. Hemorrhage of the foramen intervertebrale C5, C6 and C7. Hemorrhage of the joint Th1. Hemorrhage of the foramen intervertebrale C7.

Hemorrhage of the ligamentum longitudinale posterius and the ligamentum apicis dentis.

Extremities: No injuries.

e) AIS-Severity: Body surface 1, head 0, thorax 4, abdomen 5, vertebral column 2, extremities 0, MAIS 5.

BENDING TESTS

Run No. H 82 002

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	380	4,6	53
7th rib	188	4,5	38

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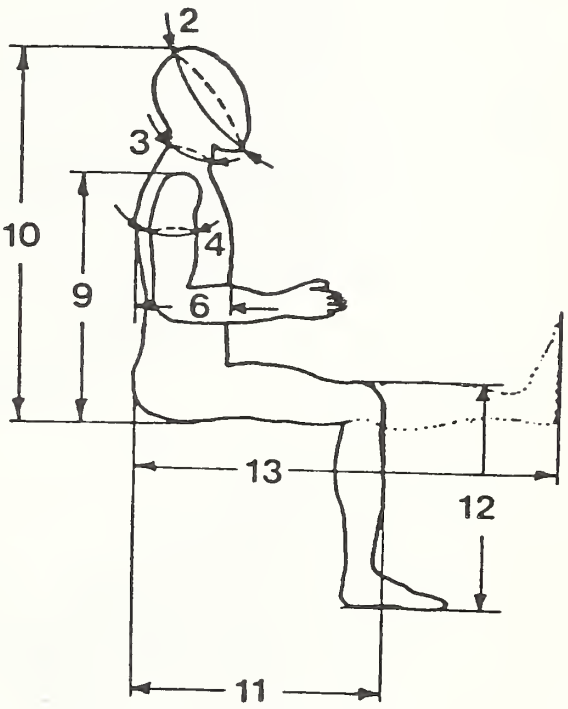
Run No. H 82 002

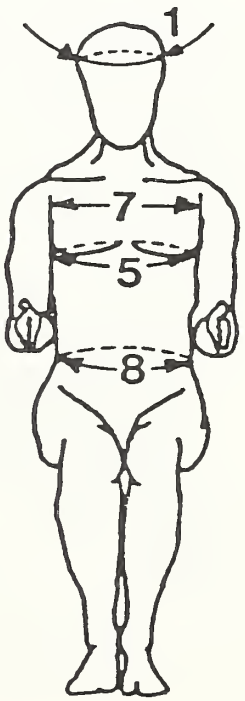
Anthropometrical Data

Body weight ..... 68 kg

Body length ..... 165 cm

1. Hat dimension ..... 53 cm
2. Head circumference ..... 63 cm
3. Neck circumfer. ..... 39 cm
4. Upper arm circumfer. ..... 3o cm
5. Chest circumfer. ..... 98 cm
6. Chest height ..... 23 cm
7. Chest width ..... 32 cm
8. Abdomen circumfer. ..... 85 cm
9. Buttocks - shoulder ..... 68 cm
10. Seat height ..... 9o cm
11. Pelvis - knee ..... 56 cm
12. Sole of foot - knee ..... 48 cm
13. Pelvis - heal ..... 94 cm





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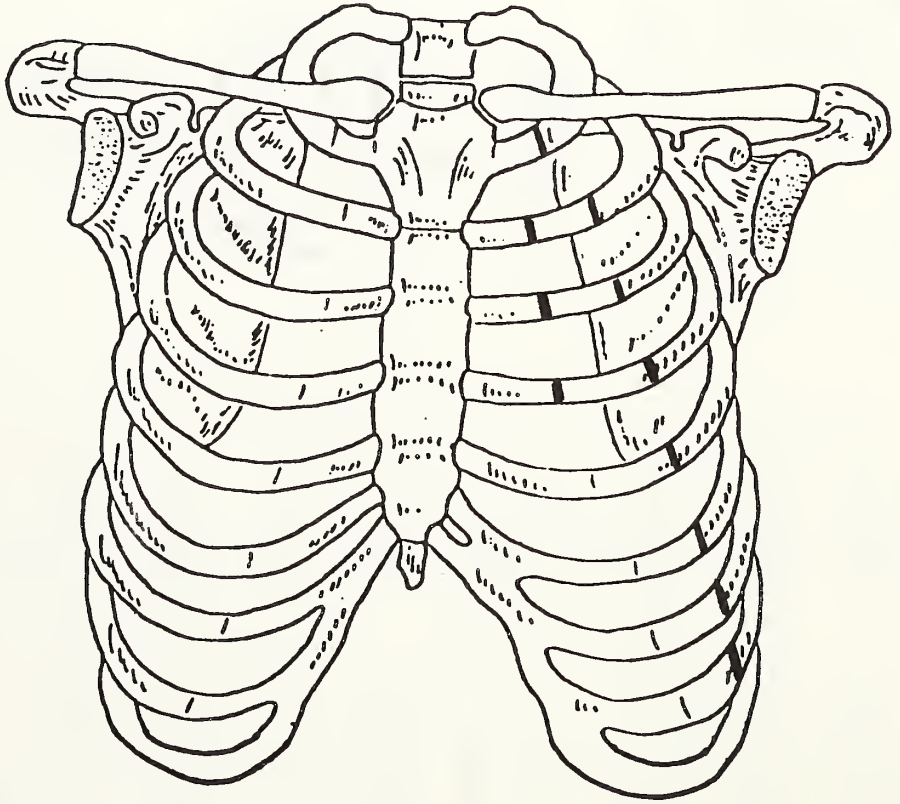
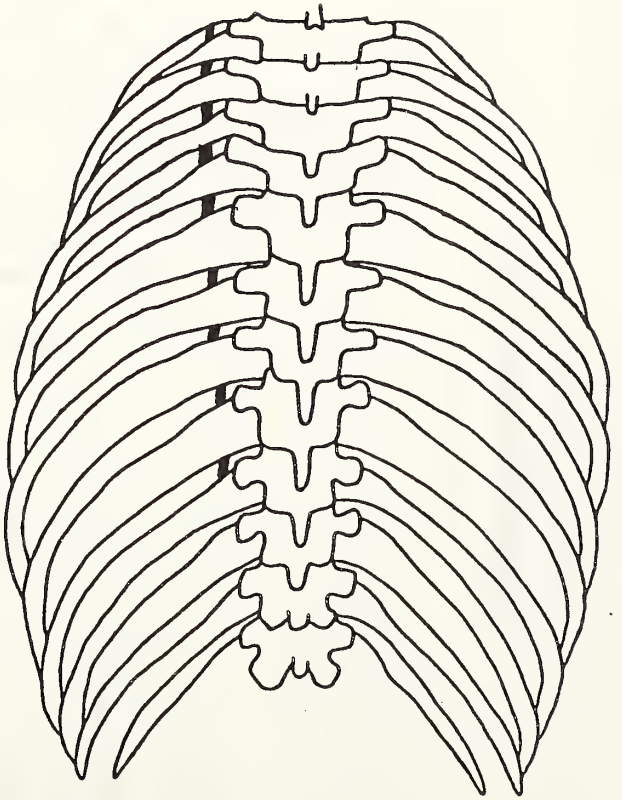
Run No. H 82 o2 DOT .....





Number of rib fractures ..2o..

Run No. H 8214

a) Subject:
Female, 22 years, body weight 61 kg, body length 178 cm, (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 1st to 12th rib left in the paravertebral region; fracture of the 2nd to the 5th, 8th and 11th rib left in the front axiallar line with transfixing of the 6th to 8th rib in the pleura.
Abdomen:	Laceration of the lower kidney pole; laceration of the kidney hilus at the backside, hemorrhage of the capsule in the kidney backside, in the kidney hilus and in the renal pelvis. Laceration between curvatura ventriculi minor of the stomach and the porta hepatis in the omentum minus.
Pelvis:	Fracture of the os pubis and the os ischii left. Fracture of the sacroiliac joint.
Vertebral column:	Hemorrhages in the superficial muscle layer betweeen occiput and C3 left and right. Small hemorrhages in the deep muscle layer between C1 and C3 right.

Extremities: Muscle hemorrhage in the left elbow.

e) AIS-Severity: Body surface 0, head 0, thorax 4, abdomen 5, pelvis 3, vertebral column 1, extremities 1, MAIS 5.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8214	6th	354	7,5	34,1
	7th	361	5,5	35,4

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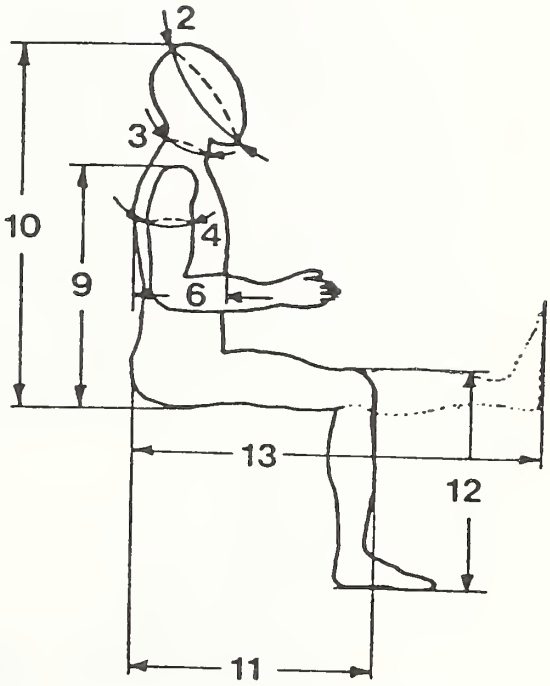
Run No. H 82 14 DOT

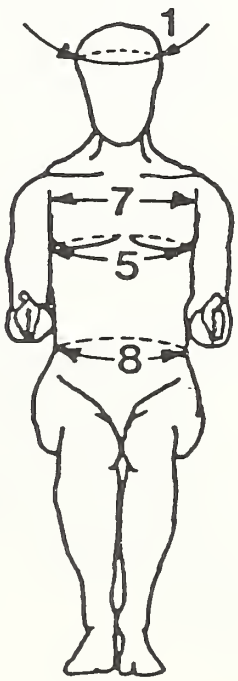
Anthropometrical Data

Body weight ..... 61 kg

Body length ..... 178 cm

1. Hat dimension ..... 55 ..... cm
2. Head circumference ..... 63 ..... cm
3. Neck circumfer. ..... 34 ..... cm
4. Upper arm circumfer. ..... 22 ..... cm
5. Chest circumfer. ..... 83 ..... cm
6. Chest height ..... 2o ..... cm
7. Chest width ..... 29 ..... cm
8. Abdomen circumfer. ..... 78 ..... cm
9. Buttocks - shoulder ..... 68 ..... cm
10. Seat height ..... 94 ..... cm
11. Pelvis - knee ..... 62 ..... cm
12. Sole of foot - knee ..... 54 ..... cm
13. Pelvis - heal ..... 1o2 ..... cm





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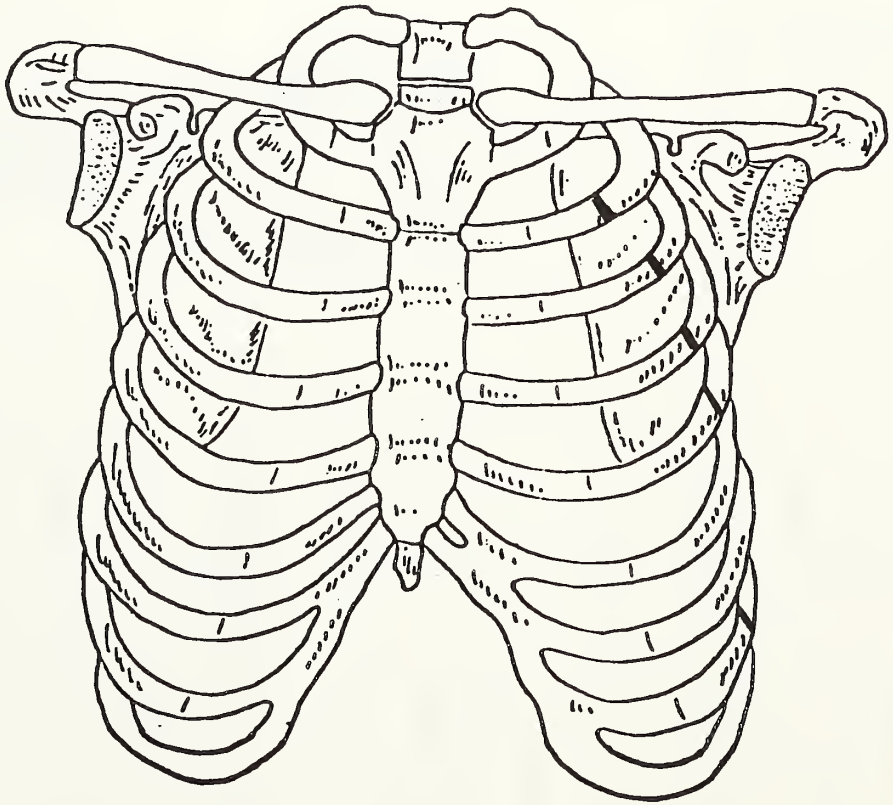
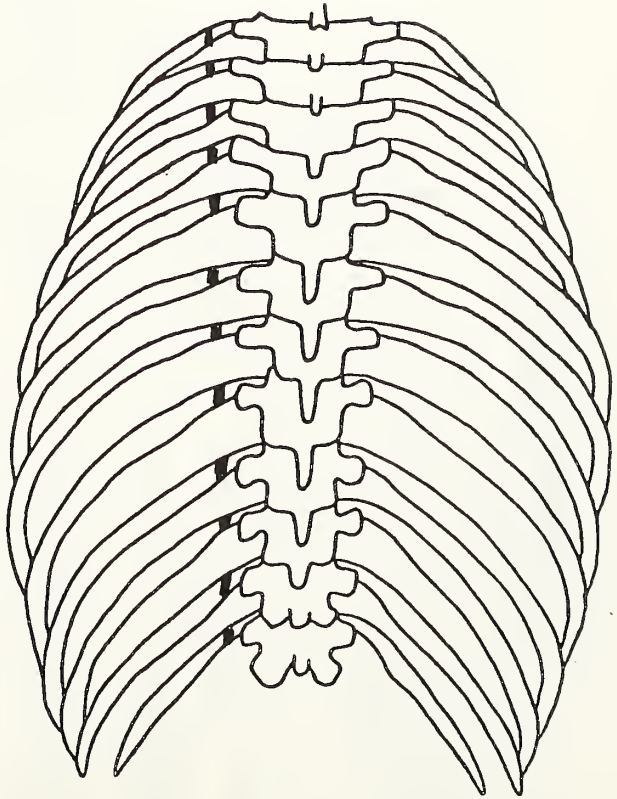
H 82 14 DOT
Run No. .....





Number of rib fractures ..18...

Run No. H 8216

a) Subject:
Male, 21 years, body weight 50 kg, body length 187 cm, (further anthropometric data s. incl.), cause of death: pneumonia.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 31 km/h.

c) Instrumentation: Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 3rd to 10th rib left in the paravertebral region; fracture of the 4th to 6th rib left in the front axiallar line.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral column:	Hemorrhages in the spinal canal between Th2 and Th4 dorsal.
Extre-mities:	Fracture of the humerus left in the upper third of the shaft.
e) AIS-Severity:	Body surface 0, head 0, thorax 3, abdomen 0, pelvis 0, vertebral column 1 extremities 2, MAIS 3.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8216	6th	280	5,0	28,0
	7th	318	7,9	29,9

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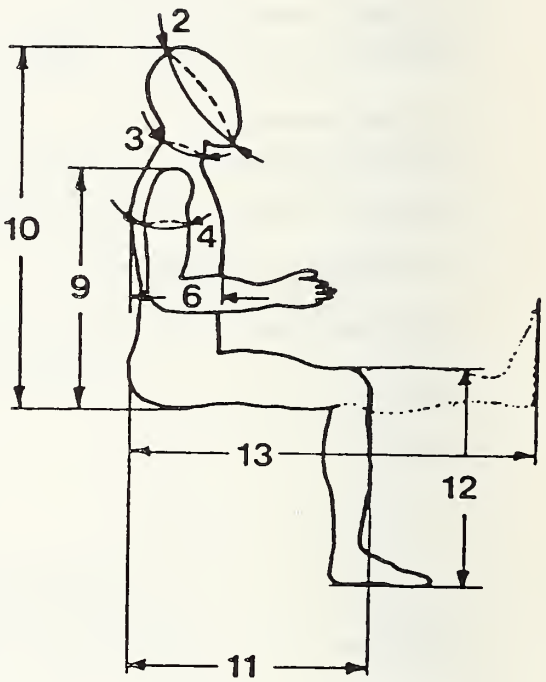
Run No. H 82 16 DOT

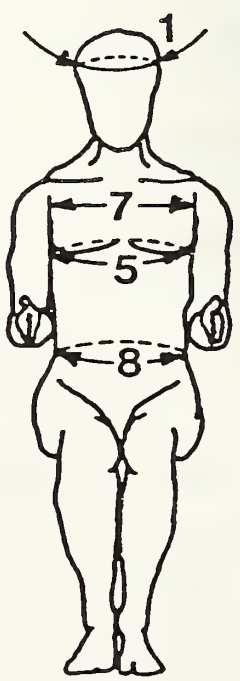
Anthropometrical Data

Body weight ...50. kg

Body length ...187. cm

1. Hat dimension .....58.....cm
2. Head circumference.....66.....cm
3. Neck circumfer. .....37...cm
4. Upper arm circumfer. ...25...cm
5. Chest circumfer. .....84.....cm
6. Chest height .....2o.....cm
7. Chest width .....27...cm
8. Abdomen circumfer. .....71...cm
9. Buttocks - shoulder .....73...cm
10. Seat height .....1oo.....cm
11. Pelvis - knee .....6o.....cm
12. Sole of foot - knee .....56.....cm
13. Pelvis - heal .....1o2.....cm





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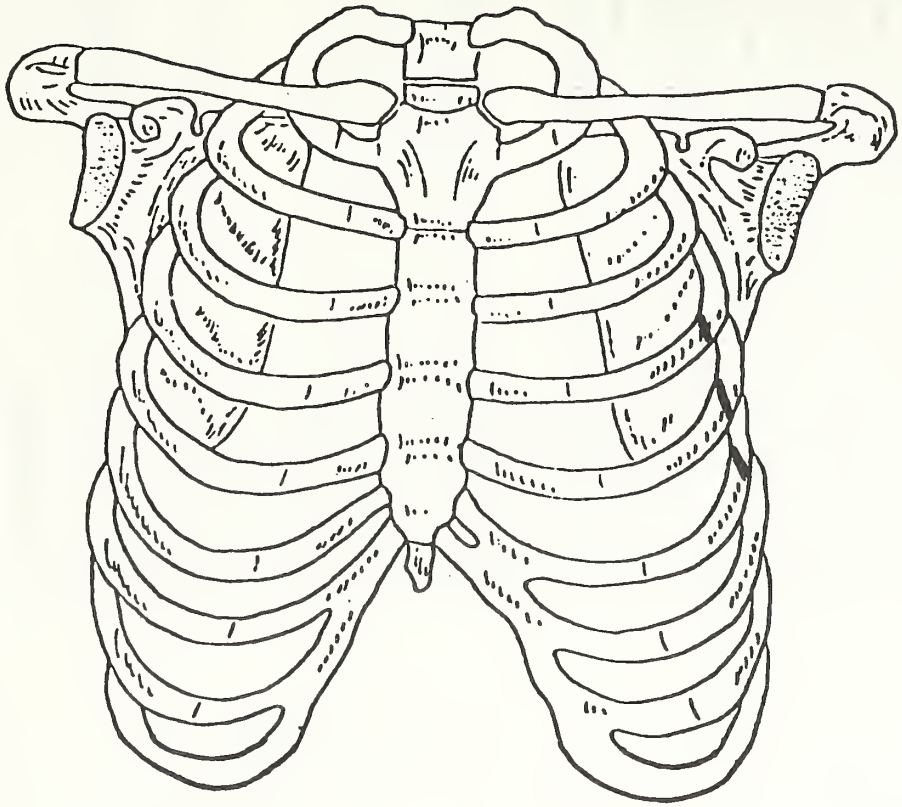
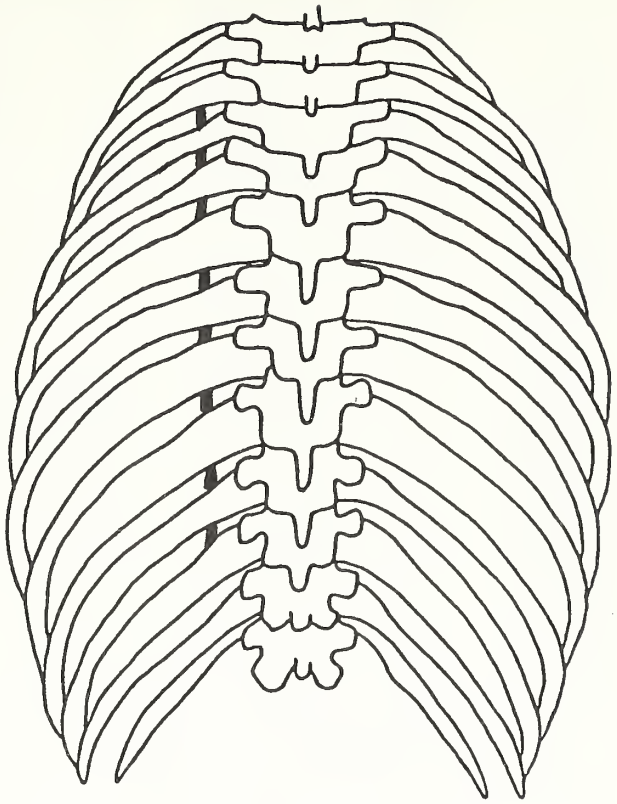
Run No. H 82 16 DOT .....





Number of rib fractures .....11.....

Run No. 8220

a) Subject:
Male, 41 years, body weight 73 kg, body length 180 cm, (further anthropometric data s. incl.), cause of death: heart failure.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 31 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the clavicle left. Fracture of the 1st to 8th rib left paravertebral. Fracture of the 1st and 2nd rib right in the medium scapula line. Fracture of the 2nd to 8th rib left in the front axillar line; fracture of the 6th and 7th rib left in the medium axillar line. Fracture of the 7th rib right in the front axillar line.
Abdomen:	Rupture of the liver at the left convexity, multiple spleen ruptures.
Pelvis:	Fracture of the ala ossis ilii left (length of the fracture 10 cm).
Vertebral column:	No injuries.
Extremities:	Skin abrasion over the left elbow.
e) AIS-Severity:	Body surface 0, head 0, thorax 4, abdomen 5, pelvis 2, vertebral column 0, extremities 1, MAIS 5.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8220	6th	216	3,8	25,9
	7th	152	3,2	22,1

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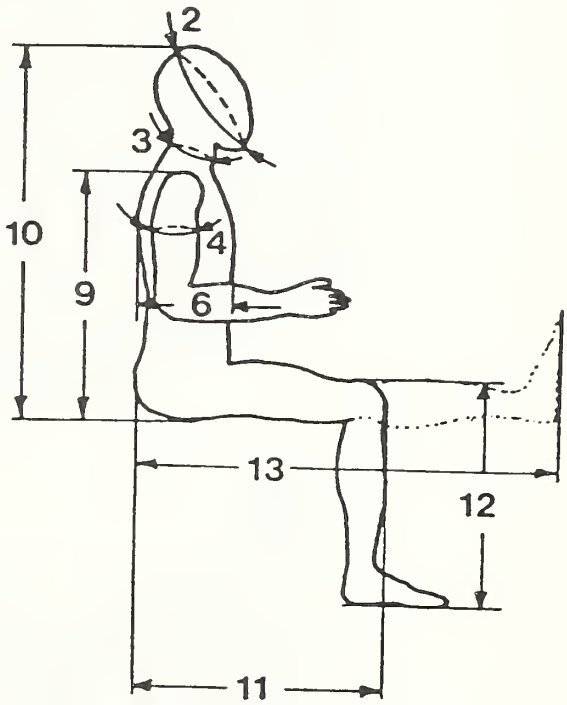
Run No. H 82 2o DOT

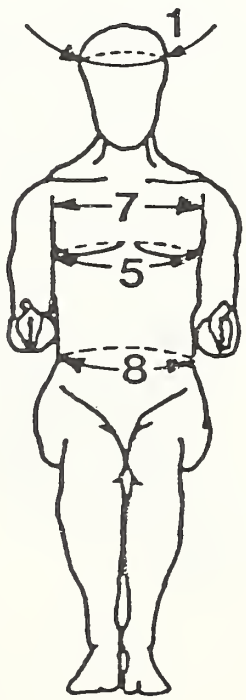
Anthropometrical Data

Body weight ..... 73 kg

Body length ..... 18o cm

1. Hat dimension .....55..cm
2. Head circumference.....66...cm
3. Neck circumfer. .....39...cm
4. Upper arm circumfer. .....27...cm
5. Chest circumfer. .....89...cm
6. Chest height .....22...cm
7. Chest width .....32...cm
8. Abdomen circumfer. .....76...cm
9. Buttocks - shoulder .....7o...cm
10. Seat height .....94...cm
11. Pelvis - knee .....6o...cm
12. Sole of foot - knee .....54...cm
13. Pelvis - heal .....1o4...cm





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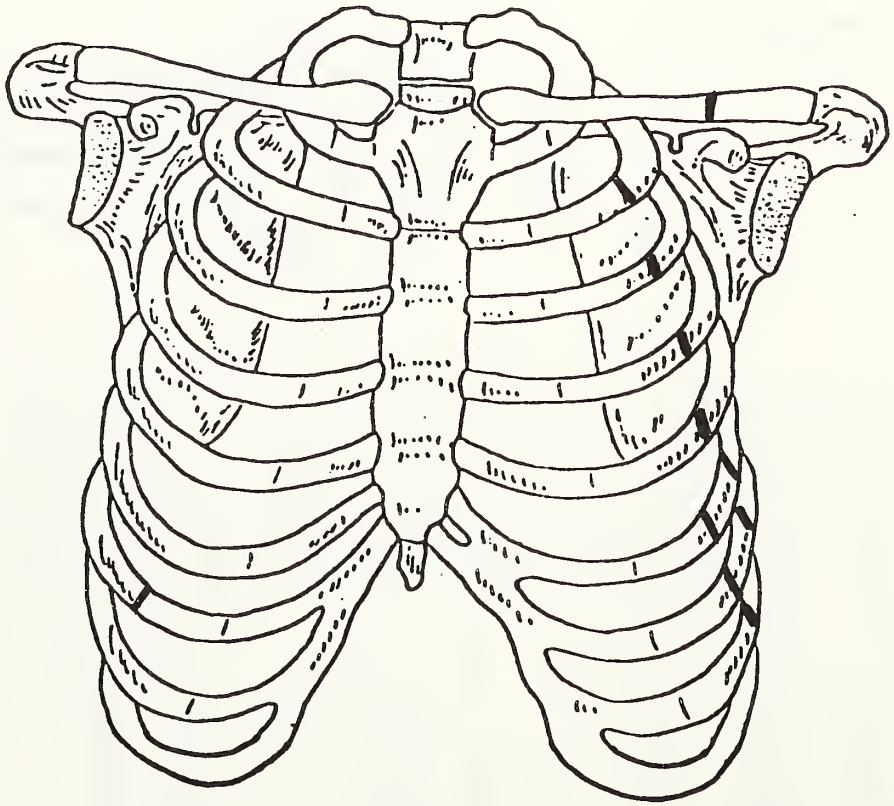
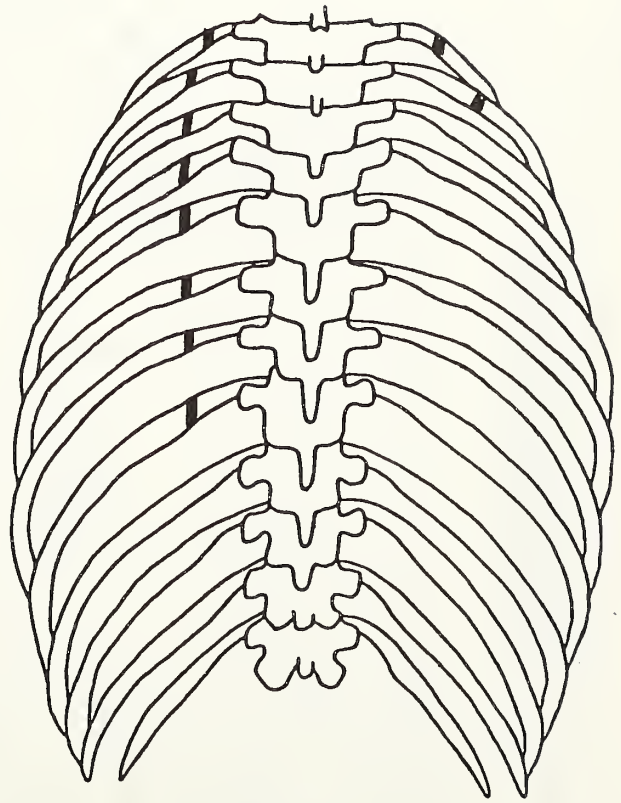
Run No. H 82 2o DOT .....





Number of rib fractures 2o .....

APPENDIX III

LATERAL IMPACT CADAVER TESTS INTO A RIGID WALL

IMPACT VELOCITY :

40 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm circ cm	Chest circumf. cm
H 8116	male	22	77	174	56	64	42	29	93
H 8122	male	23	76	178	57	68	41	30	90
H 8127	male	30	77	180	55	67	36	26	89
H 8209	female	27	51	166	53	62	31	23	76
H 8212	male	17	75	172	54	66	44	32	96
5	M 4 F 1	23.8	71.2	174	55	65	38.8	28	88.8

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8116	22	32	85	67	97	58	52	99
H 8122	23	30	80	73	100	56	51	97
H 8127	22	31	76	69	91	60	54	100
H 8209	18	28	67	64	90	55	48	93
H 8212	33	34	88	65	86	50	50	80
5	23.6	31	79.2	67.6	92.8	55.8	51	93.8

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8116	rig.wall	40	15	15	7	8	0	0	0
H 8122	rig.wall	40	22	21	9	12	1	0	1
H 8127	rig.wall	40	9	9	7	2	0	0	0
H 8209	rig.wall	40	21	20	1	19	1	0	1
H 8212	rig.wall	40	17	17	7	10	0	0	0
5	rig.wall	40	17	15	5.2	10	.4	0	.4

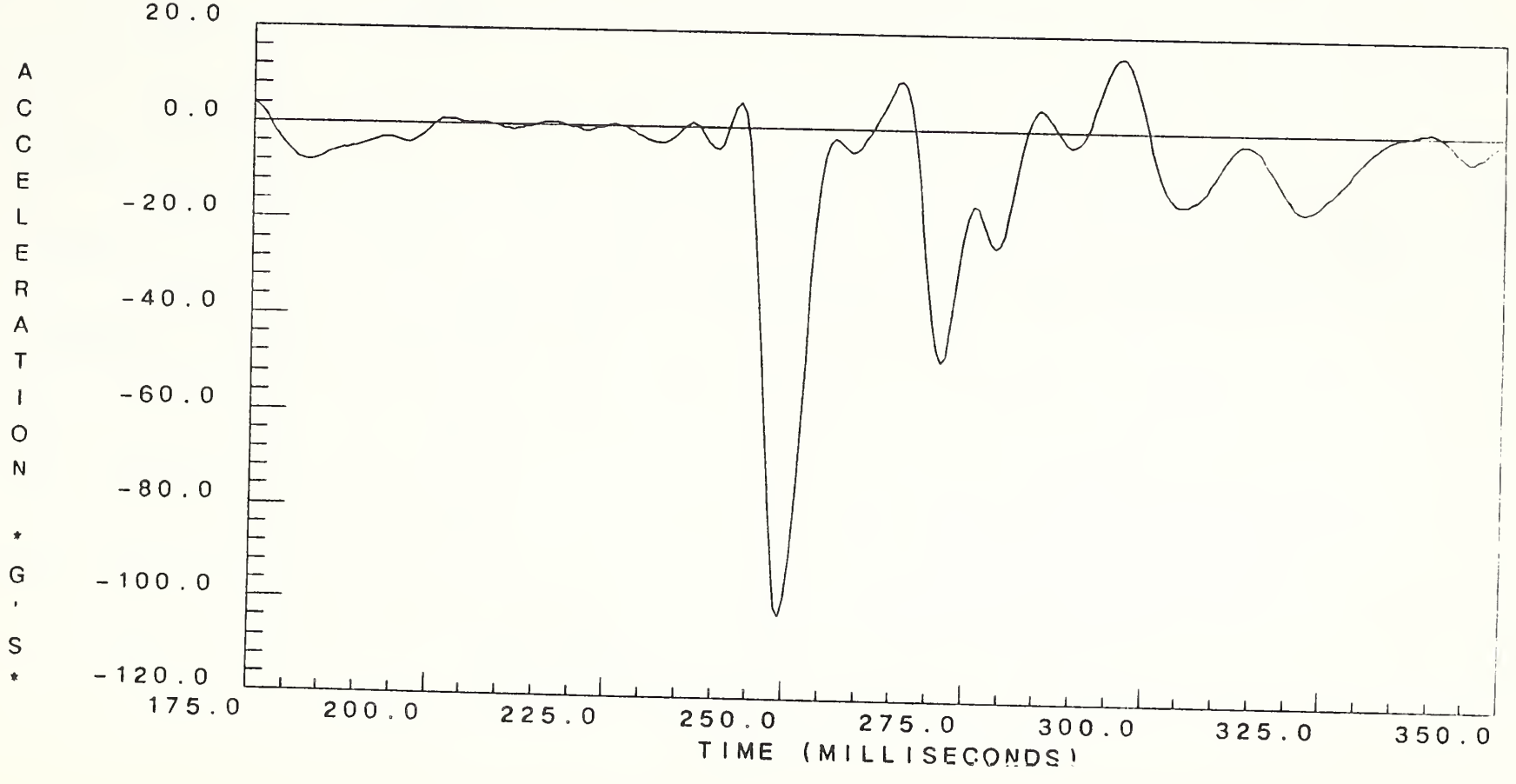
AIS - SEVERITY

Run No	Body Sur- face	Head	Thorax	Abdomen	Pelvis	Spine	Extrem .	MAIS
H 8116	0	0	4	5	0	1	0	5
H 8122	0	0	4	4	0	0	0	4
H 8127	0	0	3	5	0	2	0	5
H 8209	1	0	5	2	3	1	3	5
H 8212	1	0	5	5	0	0	2	5
5	.4	0	4	4	.6	.8	1	5

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
H 8116	448	3.7	42	352	3.8	42
H 8122	298	5.6	39	311	4.9	43
H 8127	291	4.5	34	388	5.5	50
H 8209	149	6.2	18.2	110	6.4	21.4
H 8212	254	7.0	31.2	315	6.8	44.9
5	288	5.4	32.68	294.8	5.48	40.26

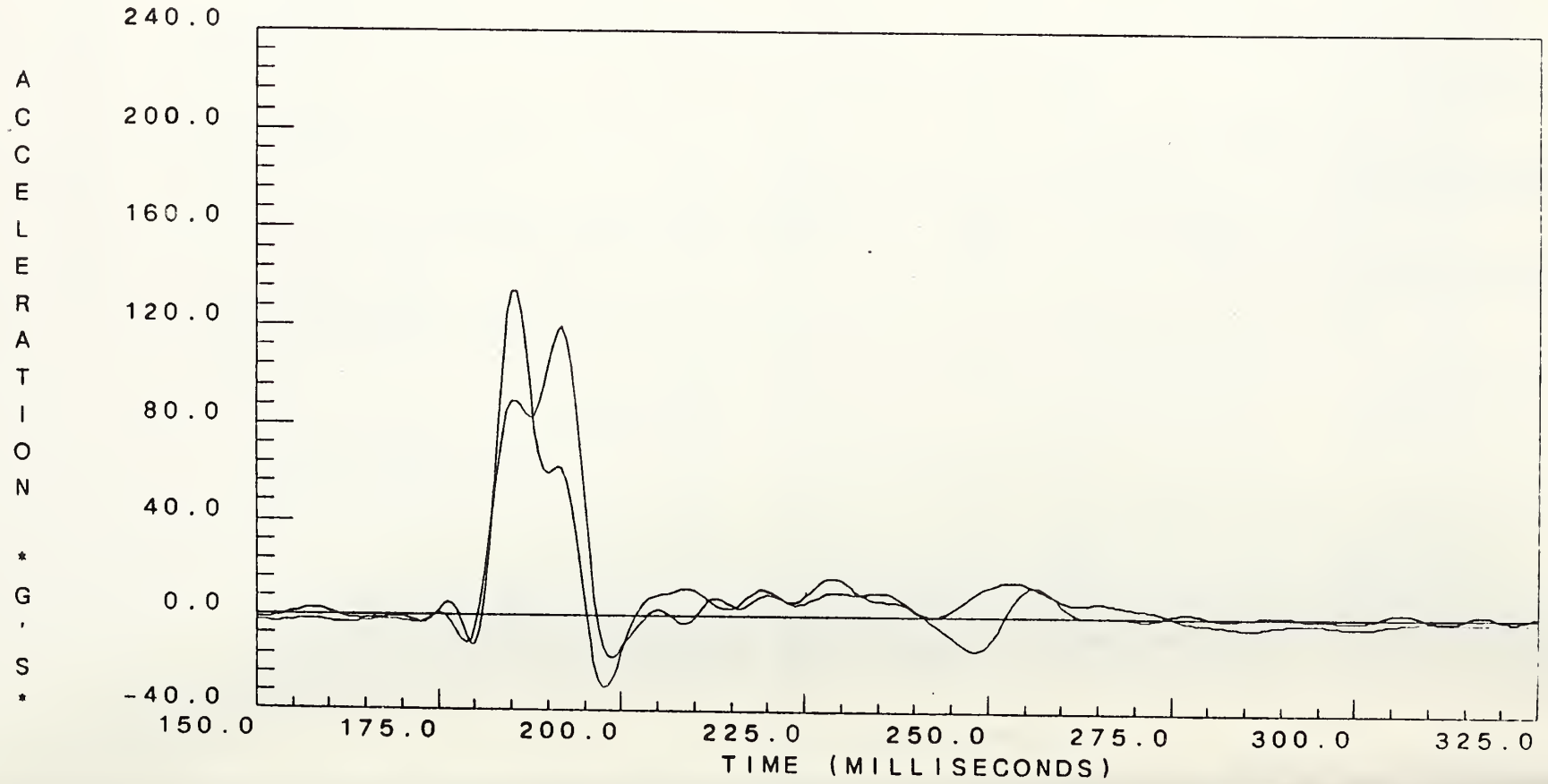
Side Impact

25 MPH Rigid Wall, Upper Rib (Y)



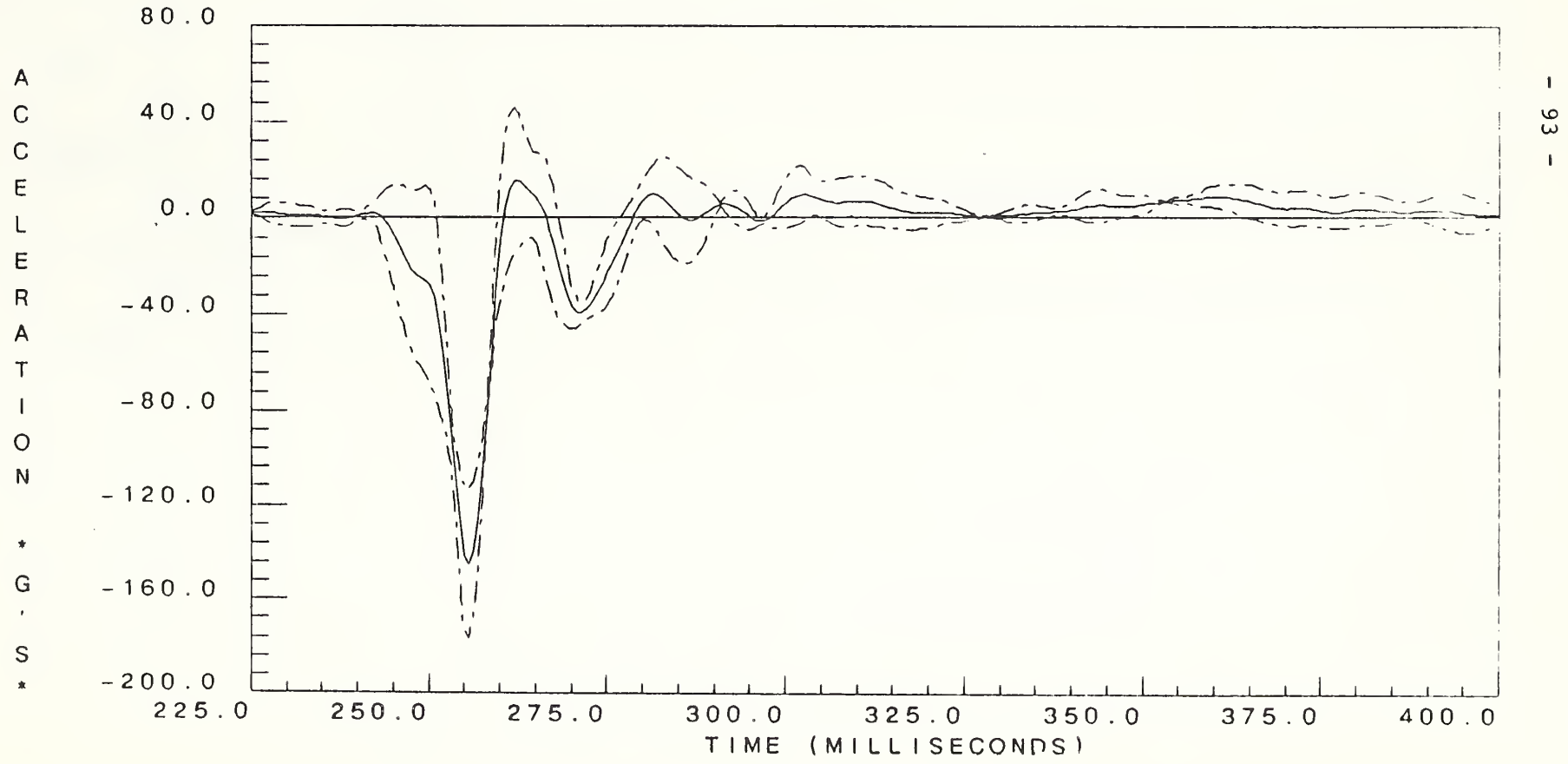
Side Impact

25 MPH Rigid Wall, Lower Rib (Y)



Mean Response with +/- 1 St. Dev. Corridor

25 MPH Rigid Wall, Upper Spine (Y)



Mean Response with +/- 1 St. Dev. Corridor

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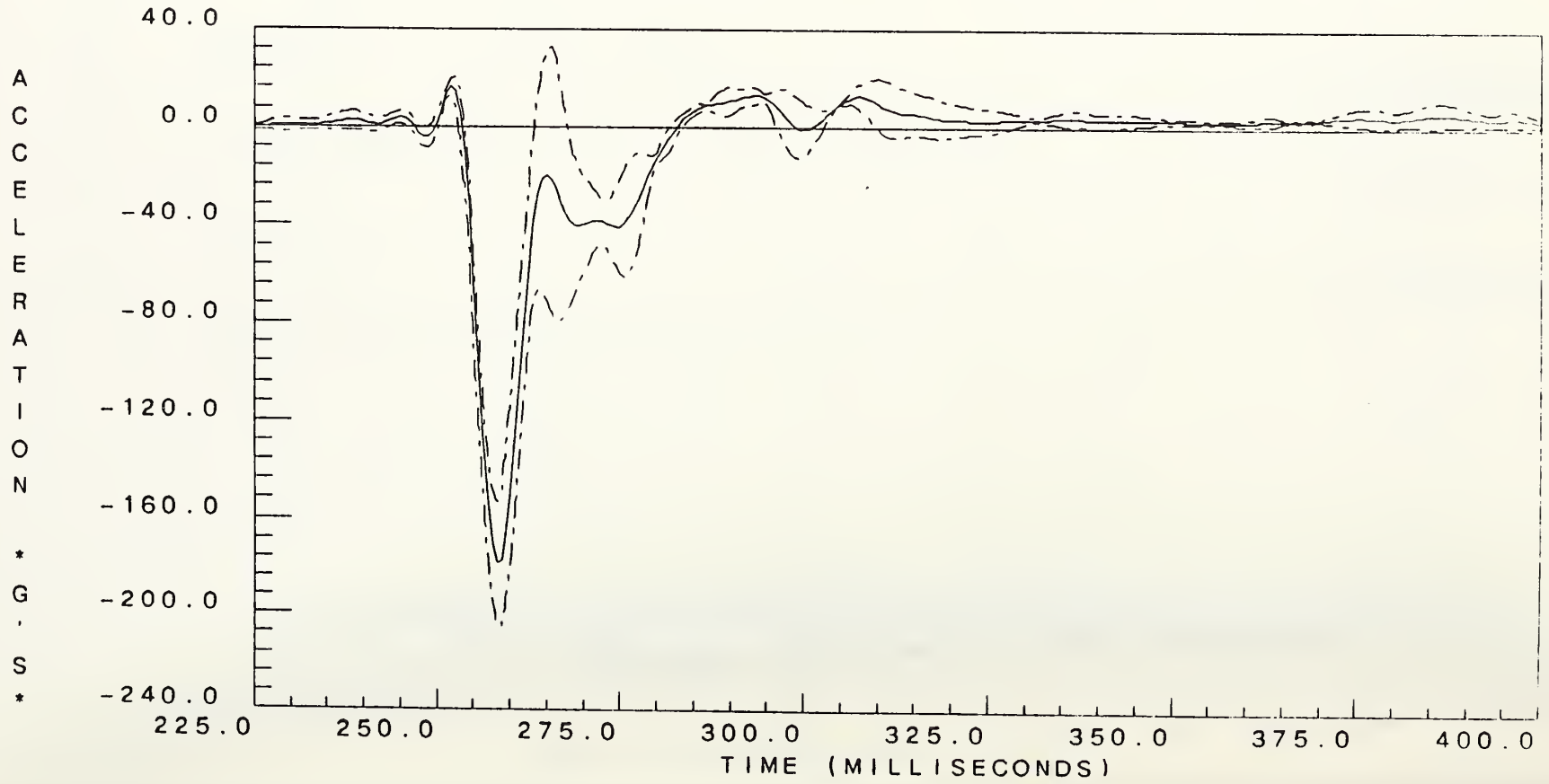
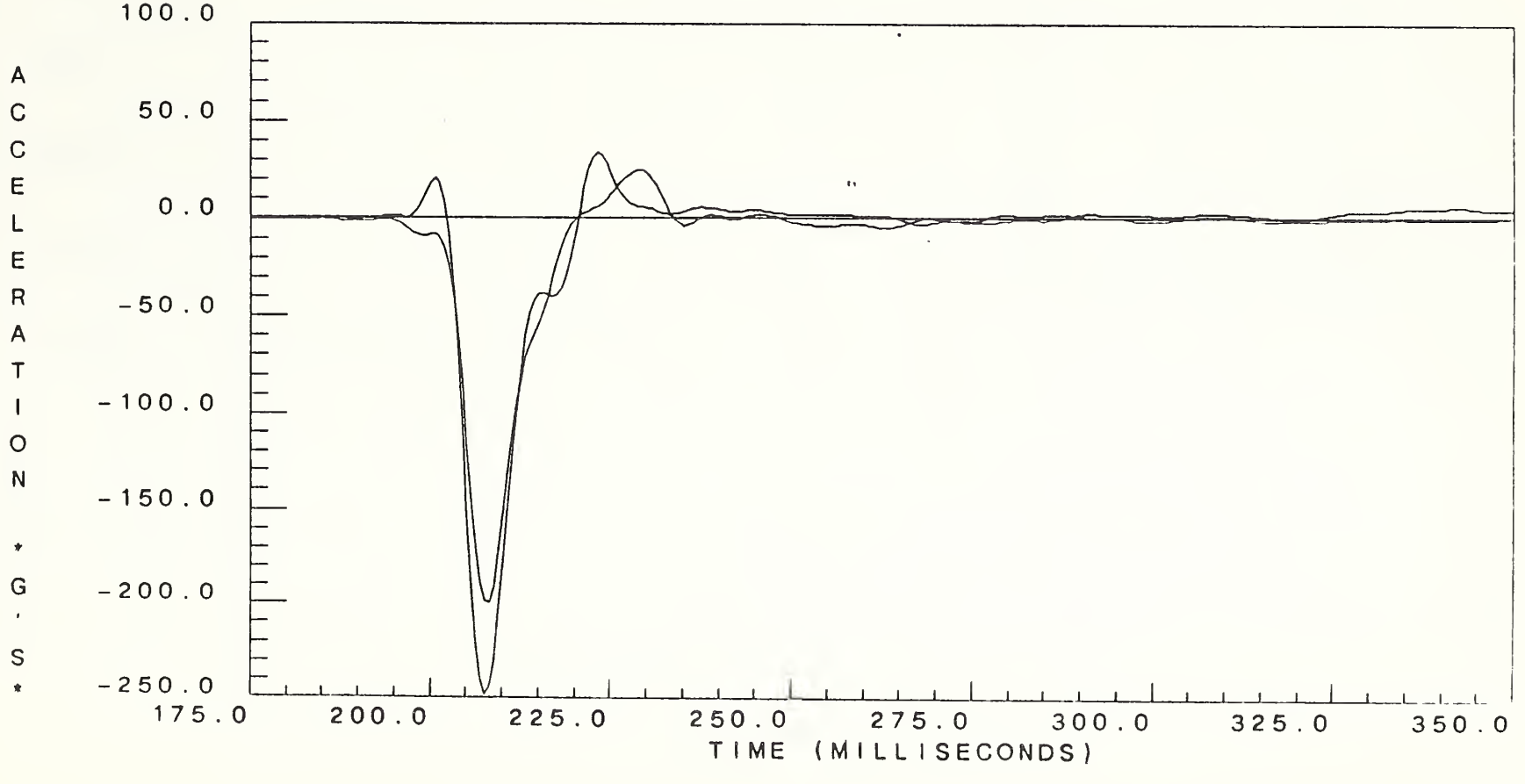


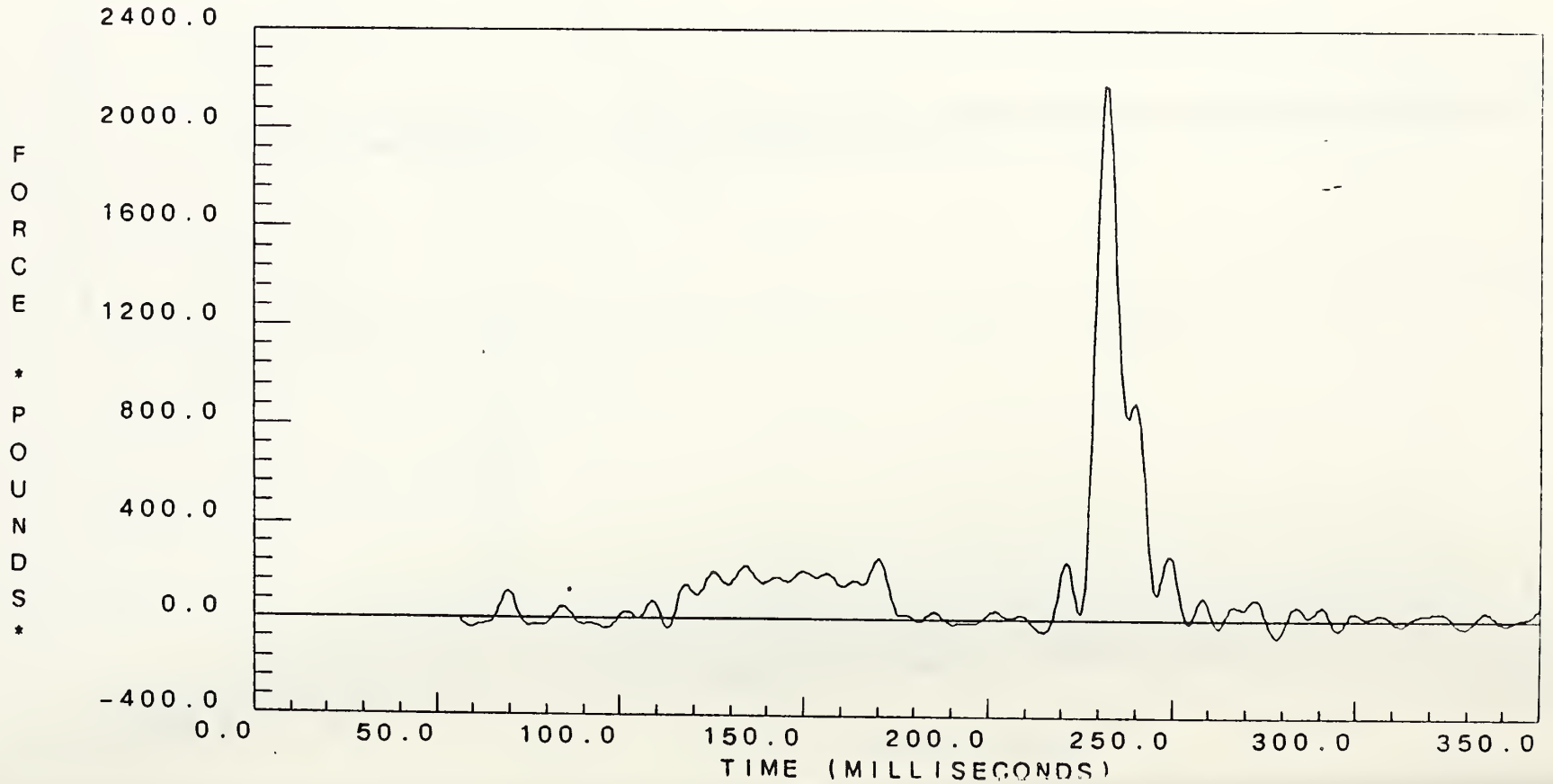
Side Impact

25 MPH Rigid Wall, Pelvis (Y)



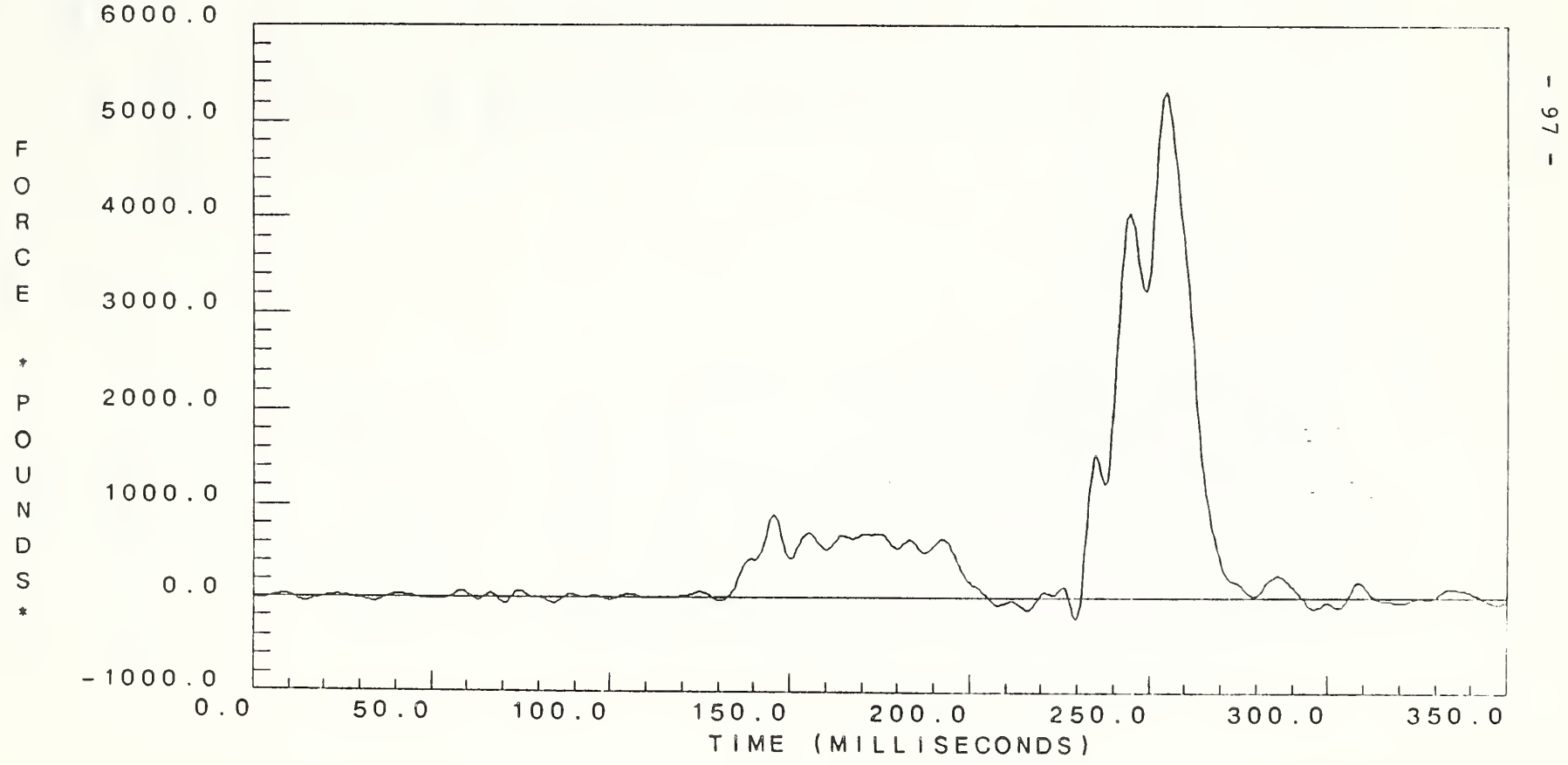
Side Impact Loads

25 MPH Rigid Wall, Pelvis (Y)



Side Impact

25 MPH Rigid Wall, Shoulder (Y)



Run No. H81016

a) Subject:
Male, 22 years, body weight 77 kg, body length 174 cm, (further anthropometric data s. incl.) cause of death: hanging.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 40 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fractures of 1st to 8th rib left in the paravertebral region. Fractures of 2nd to 8th rib left in the medium axillar line (incl.).
Abdomen:	Multiple spleen and liver ruptures.
Vertebral column:	Hemorrhage in the joint distance between C1 and C2. Hemorrhage in the ventral epidural distances of C1 to C5.
Extremities:	No injuries.
e) AIS Severity:	Body surface 0, Head 0, Thorax 4, Abdomen 5, Vertebral column 1, Extremities 0, MAIS 5.

BENDING TESTS

Run No. H81016	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	448	3,7	42
7th rib	352	3,8	42

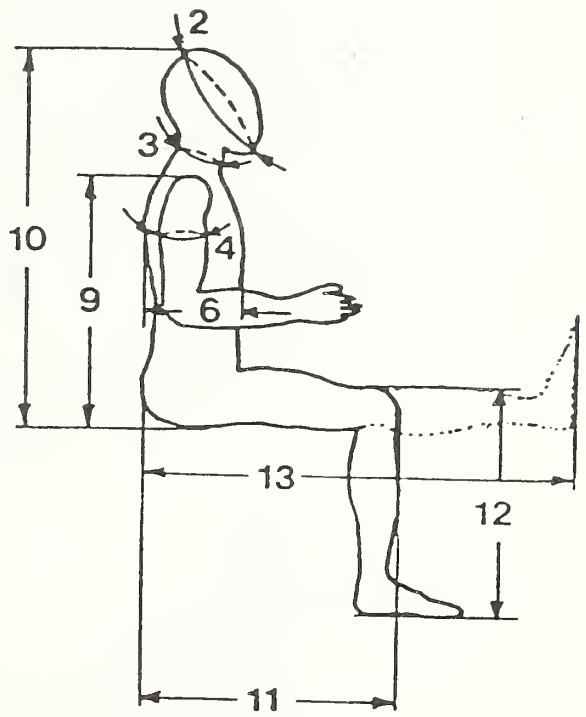
Run No. H 81 o16

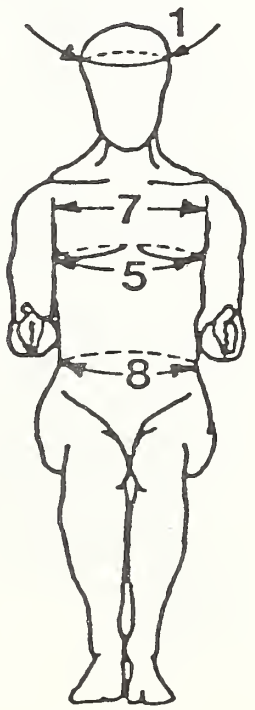
Anthropometrical Data

Body weight ....77 kg

Body length ....174 cm

1. Hat dimension .....56...cm
2. Head circumference.....64...cm
3. Neck circumfer. .....42...cm
4. Upper arm circumfer. .....29...cm
5. Chest circumfer. .....93...cm
6. Chest height .....22...cm
7. Chest width .....32...cm
8. Abdomen circumfer. .....85...cm
9. Buttocks - shoulder .....67...cm
10. Seat height .....97...cm
11. Pelvis - knee .....58...cm
12. Sole of foot - knee .....52...cm
13. Pelvis - heal .....99...cm





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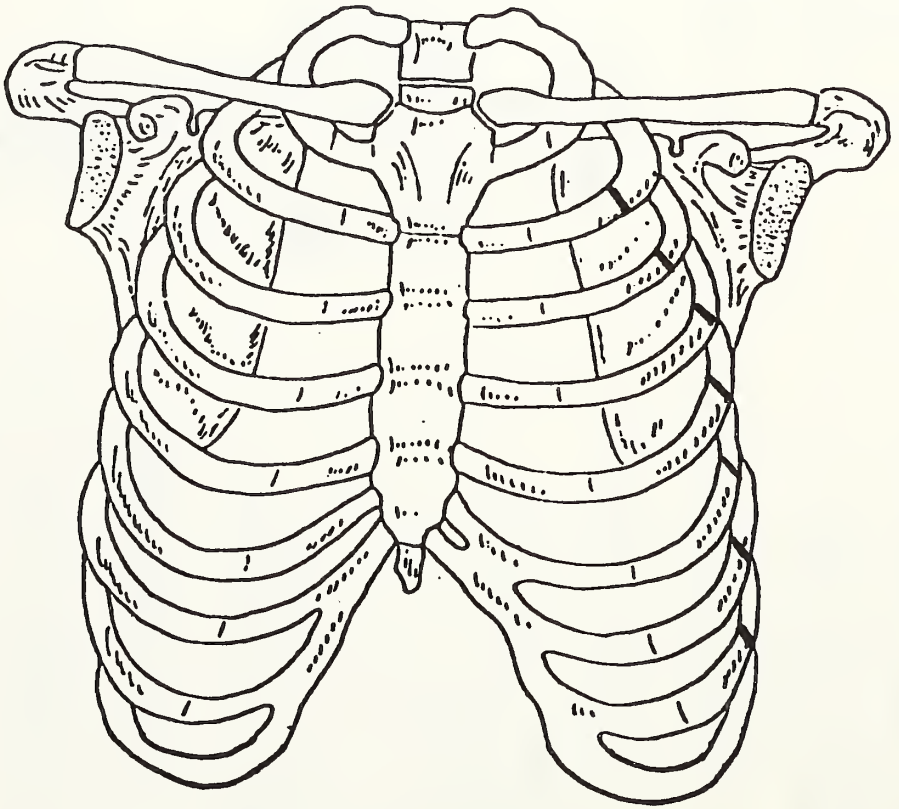
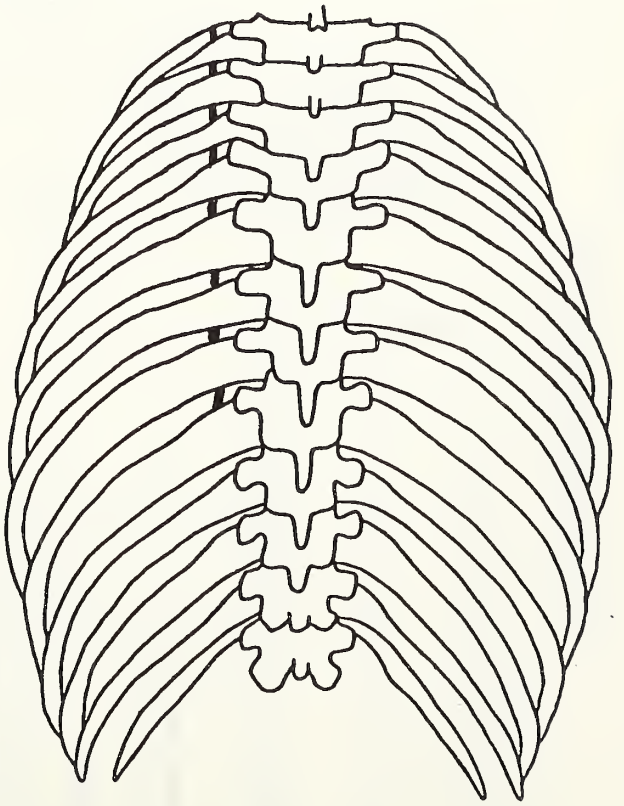
Run No. H 81 16 DOT





Number of rib fractures 15

Run No. H 81022

a) Subject:
Male, 23 years, body weight 76 kg, body length 178 cm, (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 40 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 1st to 12th rib left in the paravertebral region; fracture of the 1st to 9th rib left in the medium axillar line. Fracture of the 1st rib right in the medium scapula line (Incl.).
Abdomen:	Double rupture of the spleen.
Vertebral Column:	No injuries.
Extremities:	No injuries.

e) AIS-Severity: Body surface 0, head 0, thorax 4, abdomen 4, vertebral column 0, extremities 0, MAIS 4.

BENDING TESTS

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
Run No. H 81022			
6th rib	298	5,6	38
7th rib	311	4,9	43

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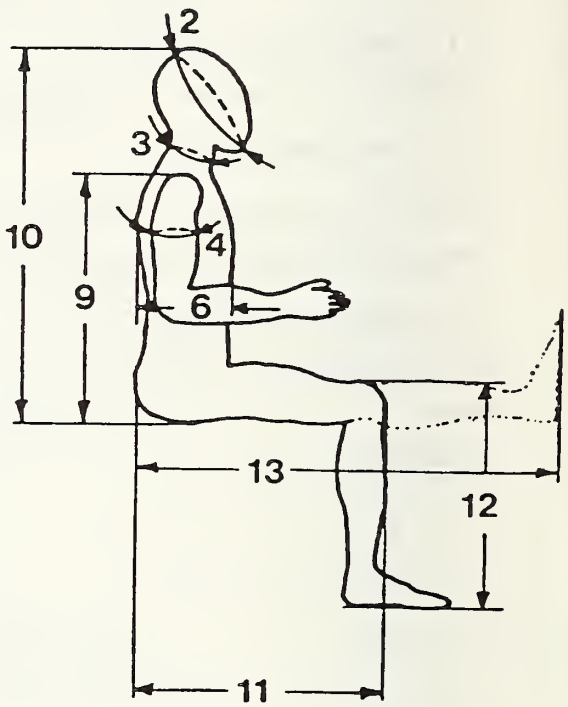
Run No. H 81 o22

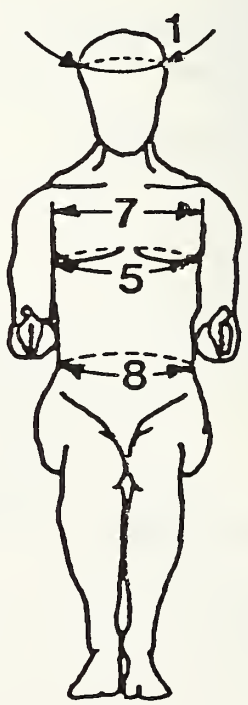
Anthropometrical Data

Body weight ..... 76 kg

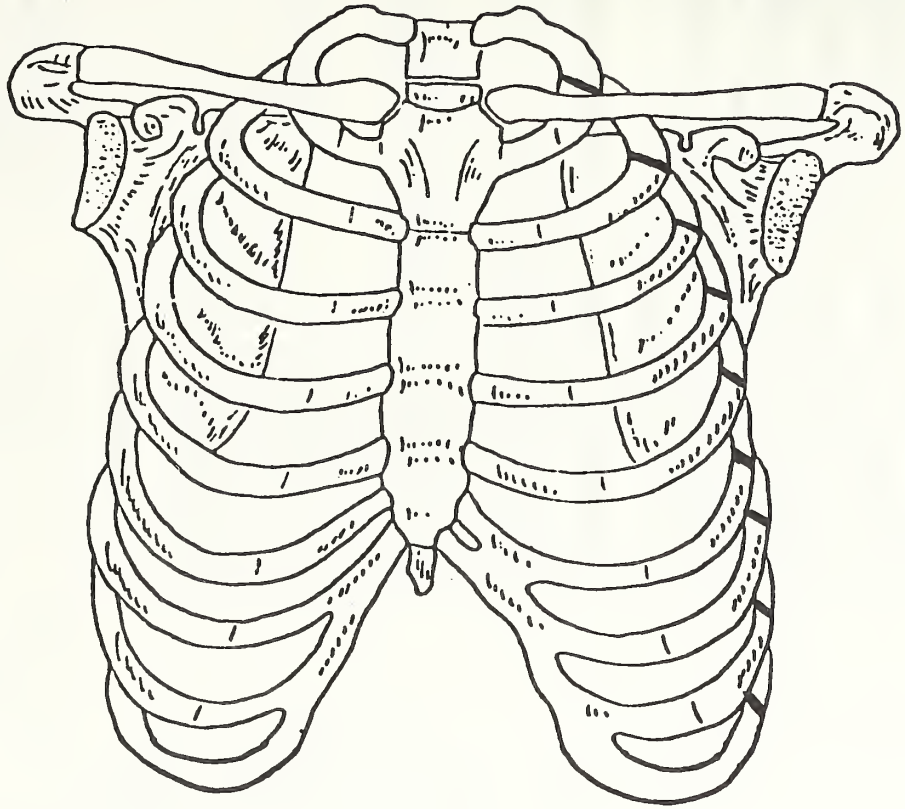
Body length ..... 178 cm

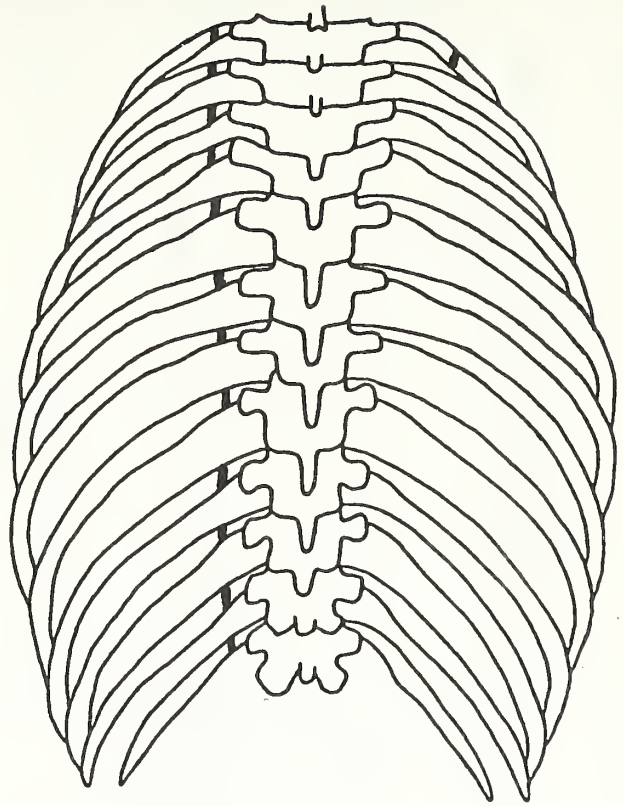
1. Hat dimension ..... 57 ..cm
2. Head circumference..... 66 ..cm
3. Neck circumfer. ..... 41 ..cm
4. Upper arm circumfer. ..... 3o ..cm
5. Chest circumfer. ..... 9o ..cm
6. Chest height ..... 23 ..cm
7. Chest width ..... 3o ..cm
8. Abdomen circumfer. ..... 8o ..cm
9. Buttocks - shoulder ..... 73 ..cm
10. Seat height ..... 1oo ..cm
11. Pelvis - knee ..... 56 ..cm
12. Sole of foot - knee ..... 51 ..cm
13. Pelvis - heal ..... 97 ..cm





Run No. H 81 22 DOT .....





Number of rib fractures 22 .....

Run No. H 81 027

a) Subject:
Male, 30 years, body weight 77 kg, body length 180 cm, (further anthropometric data s. incl.), cause of death: suffocation.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 40 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 1st and 2nd rib left in the paravertebral region; fracture of the 3d to 9th rib left in the front axillar line with small laceration of the pleura at the 3th and 4th rib (incl.).
Abdomen:	Laceration of the messokolon sigmoideum, double rupture of the spleen, double rupture of the left kidney.
Vertebral Column:	Hemorrhages and lacerations dorsal of the vertebral discs C4, C5 and C6.
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 3, abdomen 5, vertebral column 2, extremities 0, MAIS 5.

Run No. H 81 027 BENDING TESTS

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	291	4,5	34
7th rib	386	5,5	50

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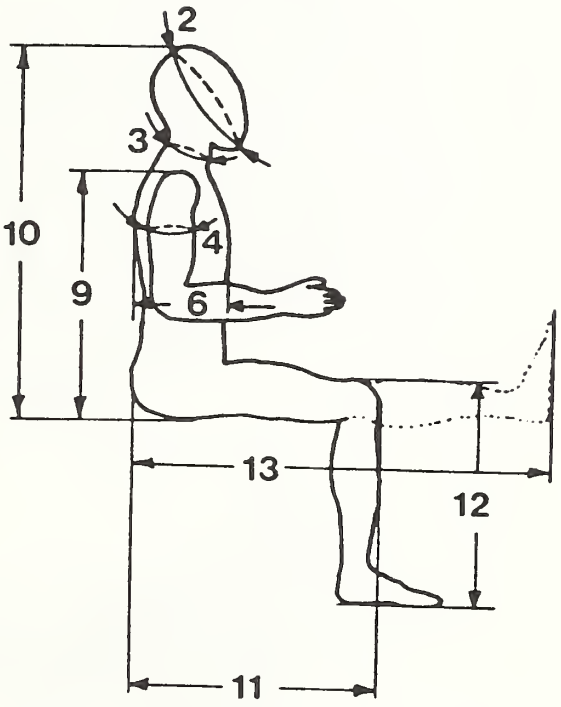
Run No. H 81 027...

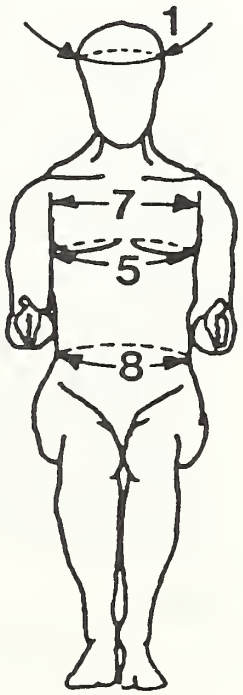
Anthropometrical Data

Body weight ....77 kg

Body length .....180 cm

1. Hat dimension .....55.....cm
2. Head circumference.....67.....cm
3. Neck circumfer. .....36.....cm
4. Upper arm circumfer. .....26.....cm
5. Chest circumfer. .....89.....cm
6. Chest height .....22.....cm
7. Chest width .....31.....cm
8. Abdomen circumfer. .....76.....cm
9. Buttocks - shoulder .....69.....cm
10. Seat height .....91.....cm
11. Pelvis - knee .....60.....cm
12. Sole of foot - knee .....54.....cm
13. Pelvis - heal .....100.....cm





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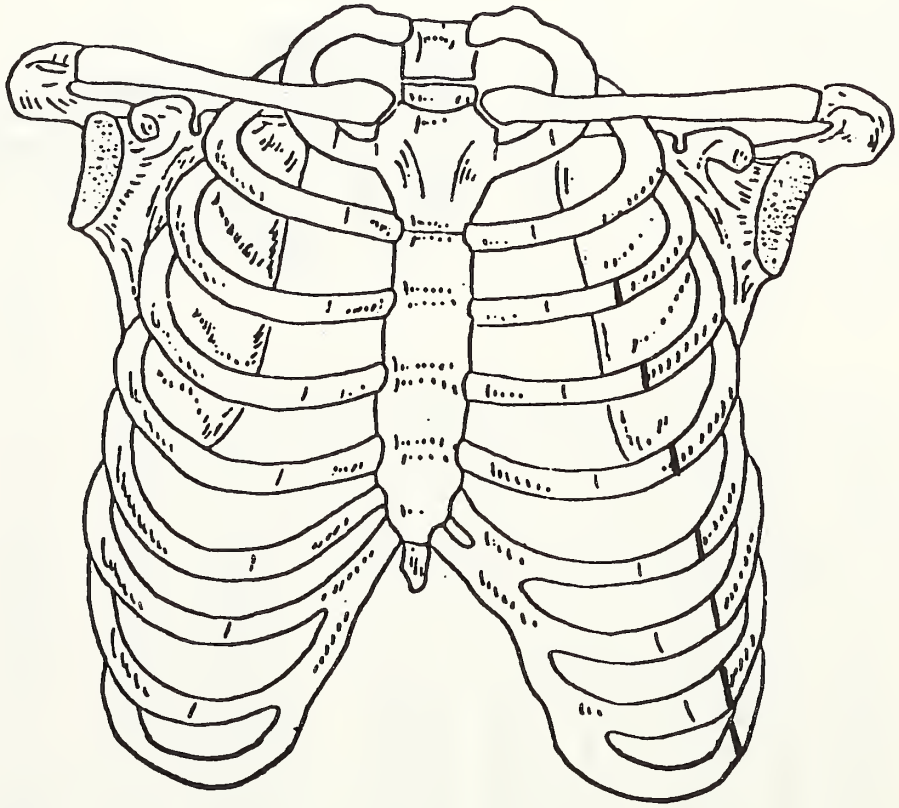
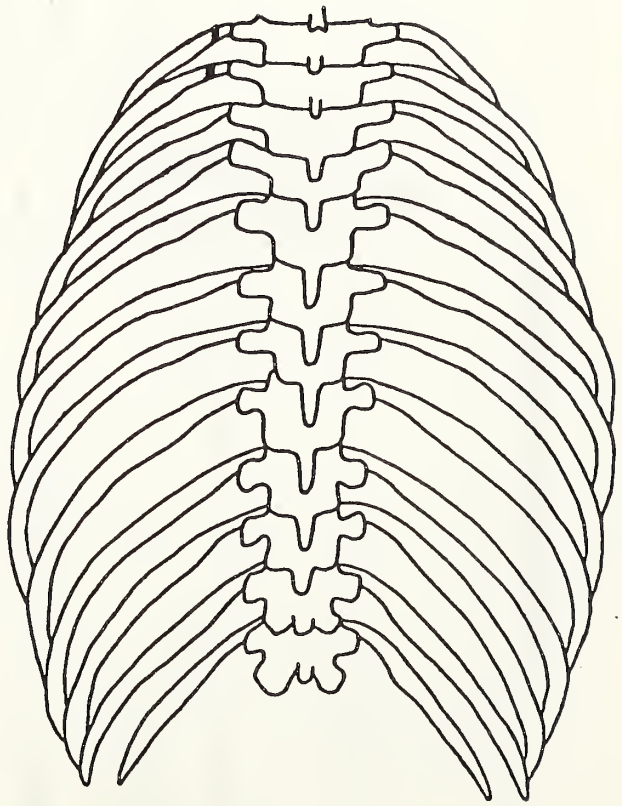
Run No. H 81 27 DOT





Number of rib fractures 9

Run No. H 8209

a) Subject:
Female, 27 years, body weight 51 kg, body length 166 cm, (further anthropometric data s. incl.), cause of death: suffocation.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 40 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	Skin abrasions over the left thigh.
Head:	No injuries.
Thorax:	Fracture of the left clavicle. Rib fractures left side: 1st rib paravertebral, 2d rib paravertebral, posterior and front axillar line, 3d to 7th rib paravertebral and in the posterior axillar line, 8th rib paravertebral and in the medium scapular line, 9th to 12th rib paravertebral. Transfixing of the pleura at the 2d, 4th, 5th and 7th rib paravertebral, further 4th, 5th and 7th rib in the posterior axillar line. Rib fractures right side: 1st rib paravertebral. Multiple transfixings of the left lung.
Abdomen:	Hemorrhage of the left kidney capsule.
Pelvis:	Comminuted fracture of the left hip bone, fracture of the upper and lower pubis left.
Vertebral Column:	Hemorrhages in the medium and deep muscle layers between C6 and Th2 left and right.

Extremities: Fracture of the left upper arm at the surgical neck. Fracture of the left femur in the middle of the shaft.

e) AIS-Severity: Body surface 1, head 0, thorax 5, abdomen 2, pelvis 3, vertebral column 1, extremities 3, MAIS 5.

BENDING TESTS

Run N° H 82 09

	max.Force (N)	max. Deflexion (mm)	Cross section (mm^2)
6th rib	149	6,2	18,2
7th rib	110	6,4	21,4

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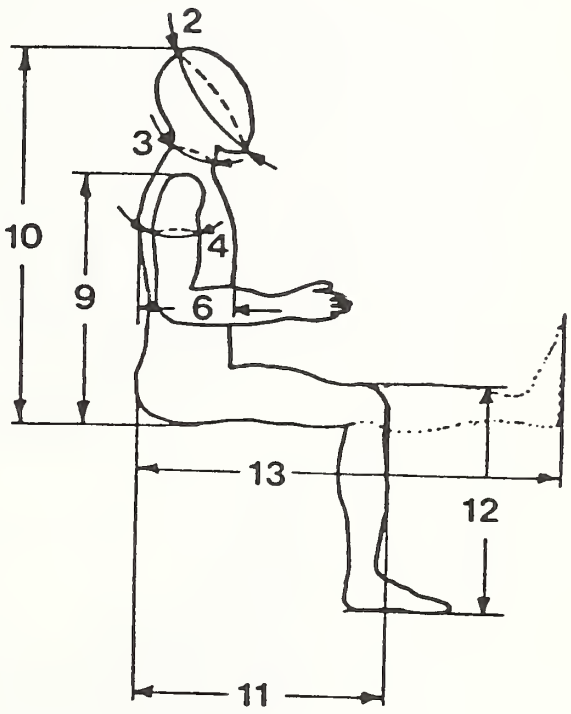
Run No. H 82 o9 DOT .....

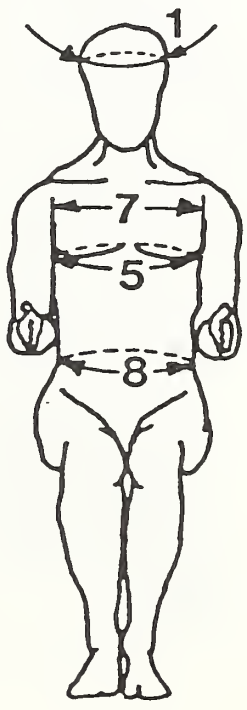
Anthropometrical Data

Body weight ...51 kg

Body length ...166 cm

1. Hat dimension .....53.....cm
2. Head circumference.....62.....cm
3. Neck circumfer. .....31.....cm
4. Upper arm circumfer. .....23.....cm
5. Chest circumfer. .....76.....cm
6. Chest height .....18.....cm
7. Chest width .....28.....cm
8. Abdomen circumfer. .....67.....cm
9. Buttocks - shoulder .....64.....cm
10. Seat height .....9o.....cm
11. Pelvis - knee .....55.....cm
12. Sole of foot - knee .....48.....cm
13. Pelvis - heal .....93.....cm





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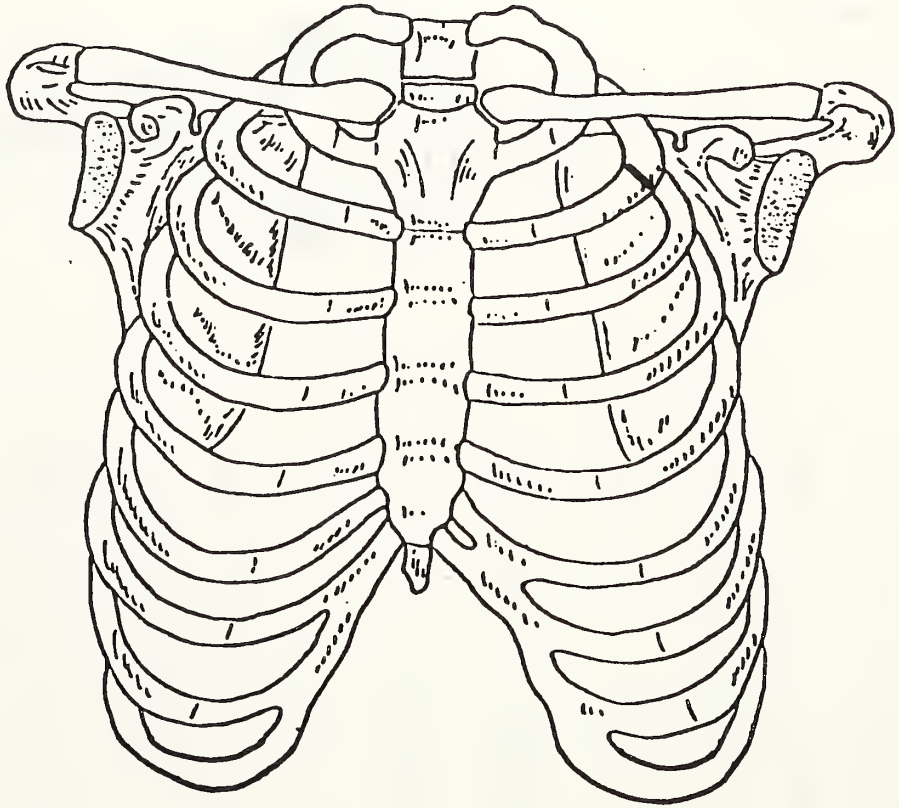
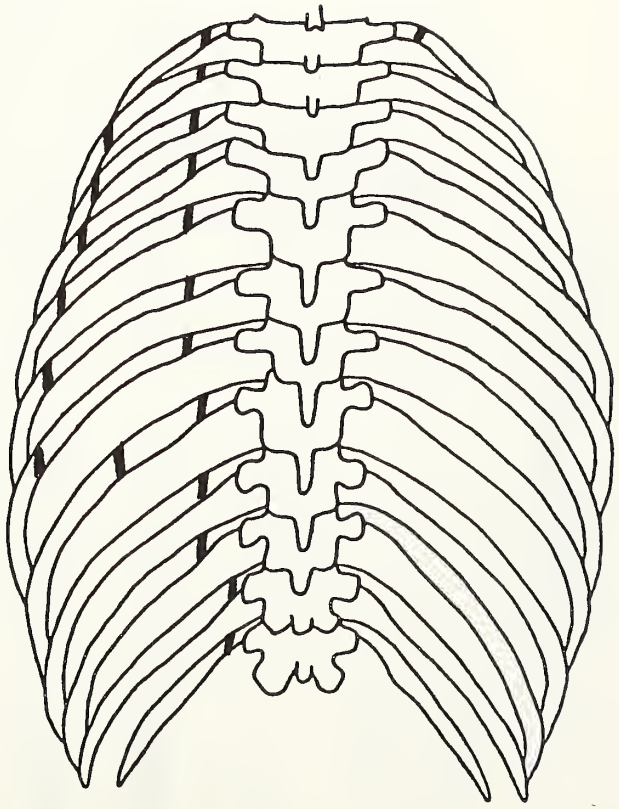
Run No. .H.82.09.DOT....





Number of rib fractures 21

Run No. H82012

a) Subject:
Male, 17 years, body weight 75kg, body length 172cm, (further anthropometric data s. incl.), cause of death: suffocation.

b) Test conditions:
Lateral collision, rigid wall, impact velocity 40km/h.

c) Instrumentation:
Sled deceleration, 9 accelerometer head, 12 accelerometer thorax, 3 accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	Skin abrasion over the upper arm, the hip and the left thigh.
Head:	No injuries.
Thorax:	Fracture of the 2d to the 10th rib left paravertebral. Fracture of the 2d to the 9th rib left from the front axillar line to the rear axillar line. Transfixing of the pleura at the 5th, 6th and 7th rib left (incl.). 5cm long laceration and 5cm deep condusion in the left lung.
Abdomen:	Multiple rupture of the spleen, laceration of the kidney hilus left.
Pelvis:	No injuries.
Vertebral Column:	No injuries.
Extremities:	Laceration of the fat tissue of the thigh left. Fracture of the humerus left in the middle of the shaft with muscle condusion in this area.

e) AIS-Severity: Body surface 1, head 0, thorax 5, abdomen 5, pelvis 0, vertebral column 0, extremities 2, MAIS 5.

BENDING TESTS

Run No. H 82 12

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	254	7	31,2
7th rib	315	6,8	44,9

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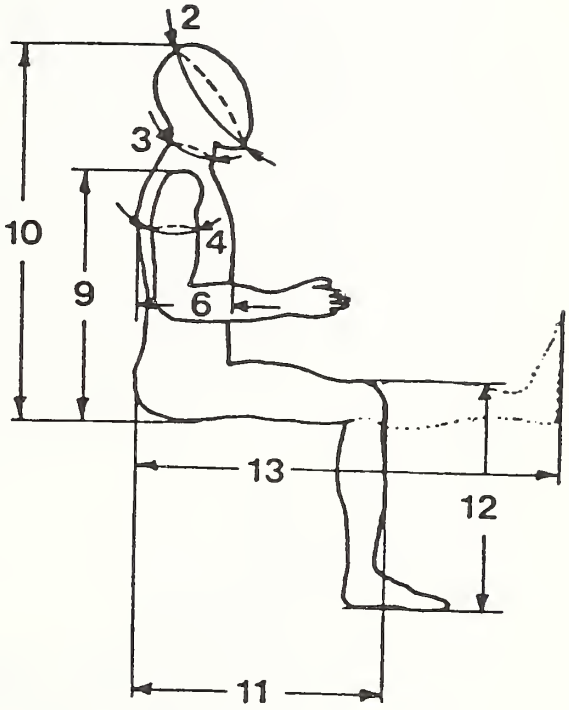
Run No. H 82 12

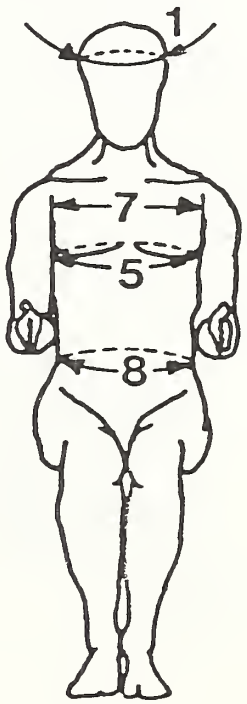
Anthropometrical Data

Body weight ....75.... kg

Body length ....172.... cm

1. Hat dimension .....54.....cm
2. Head circumference.....66.....cm
3. Neck circumfer. .....44.....cm
4. Upper arm circumfer. .....32.....cm
5. Chest circumfer. .....96.....cm
6. Chest height .....33.....cm
7. Chest width .....34.....cm
8. Abdomen circumfer. .....88.....cm
9. Buttocks - shoulder .....65.....cm
10. Seat height .....86.....cm
11. Pelvis - knee .....50.....cm
12. Sole of foot - knee .....50.....cm
13. Pelvis - heal .....80.....cm





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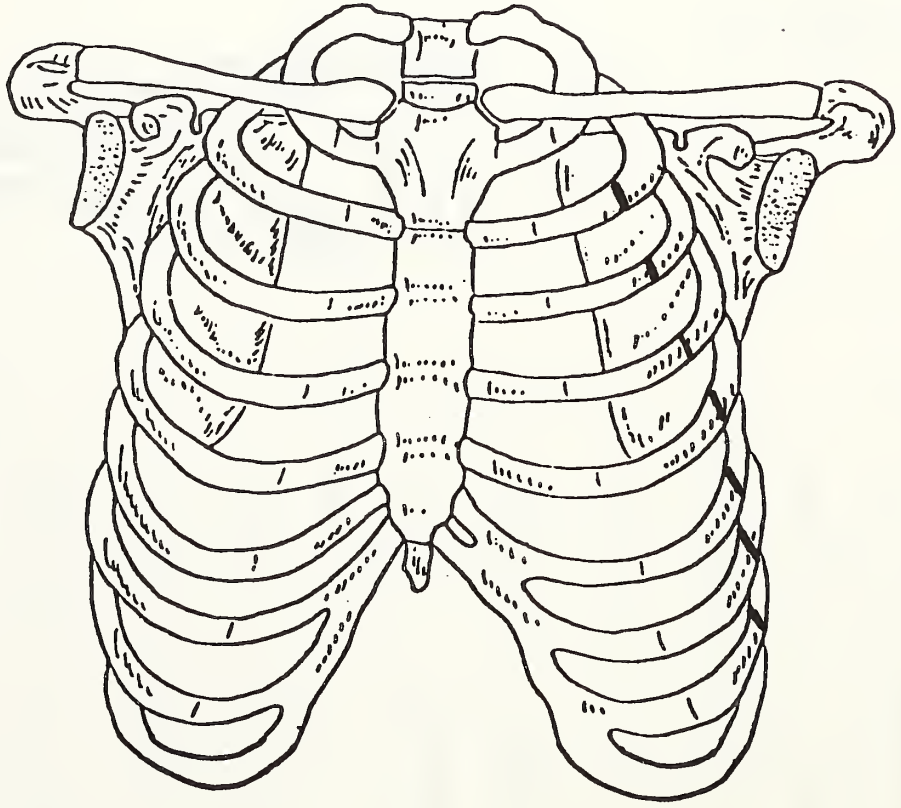
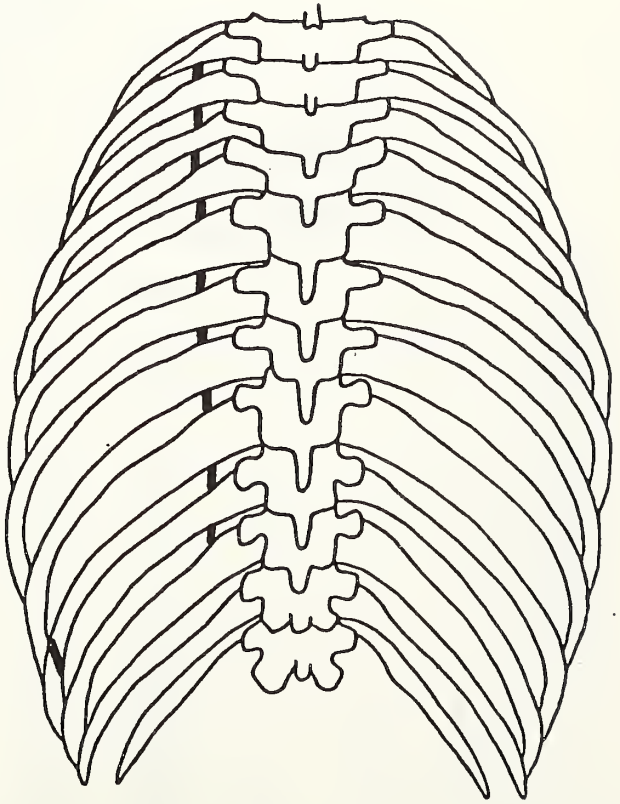
Run No. H 82 12 DOT .....





Number of rib fractures ..17..

APPENDIX IV

LATERAL IMPACT CADAVER TESTS INTO A WALL WITH HNCB PAD.

IMPACT VELOCITY : 24 KM/H, 32 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cl cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8021	male	29	63	180	56	60	39	29	90
H 8023	female	41	82	159	54	68	40	32	94
H 8111	male	43	59	165	55	62	41	26	87
H 8112	female	33	46	156	54	57	33	27	74
H 8115	male	44	73	172	52	70	34	28	92
H 8121	female	48	57	166	54	62	32	24	82
6	M 3 F 3	39.7	63.3	166.3	54.2	62.8	36.5	27.7	86.5

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8021	22	31	78	68	94	54	50	98
H 8023	24	33	98	71	94	55	49	90
H 8111	22	28	81	63	85	52	51	95
H 8112	18	26	72	63	82	53	44	90
H 8115	23	32	82	70	91	55	51	96
H 8121	21	28	81	65	87	54	50	93
6	21.7	29.7	82	66.7	88.8	53.8	49.2	93.67

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8021	HNCB pad	32	0	0	0	0	0	0	0
H 8023	HNCB pad	33	11	11	8	3	0	0	0
H 8111	HNCB pad	32	0	0	0	0	0	0	0
H 8112	HNCB pad	32	5	5	4	1	0	0	0
H 8115	HNCB pad	23	0	0	0	0	0	0	0
H 8121	HNCB pad	24	0	0	0	0	0	0	0
6	HNCB pad	29.3	2.7	2.7	2	.67	0	0	0

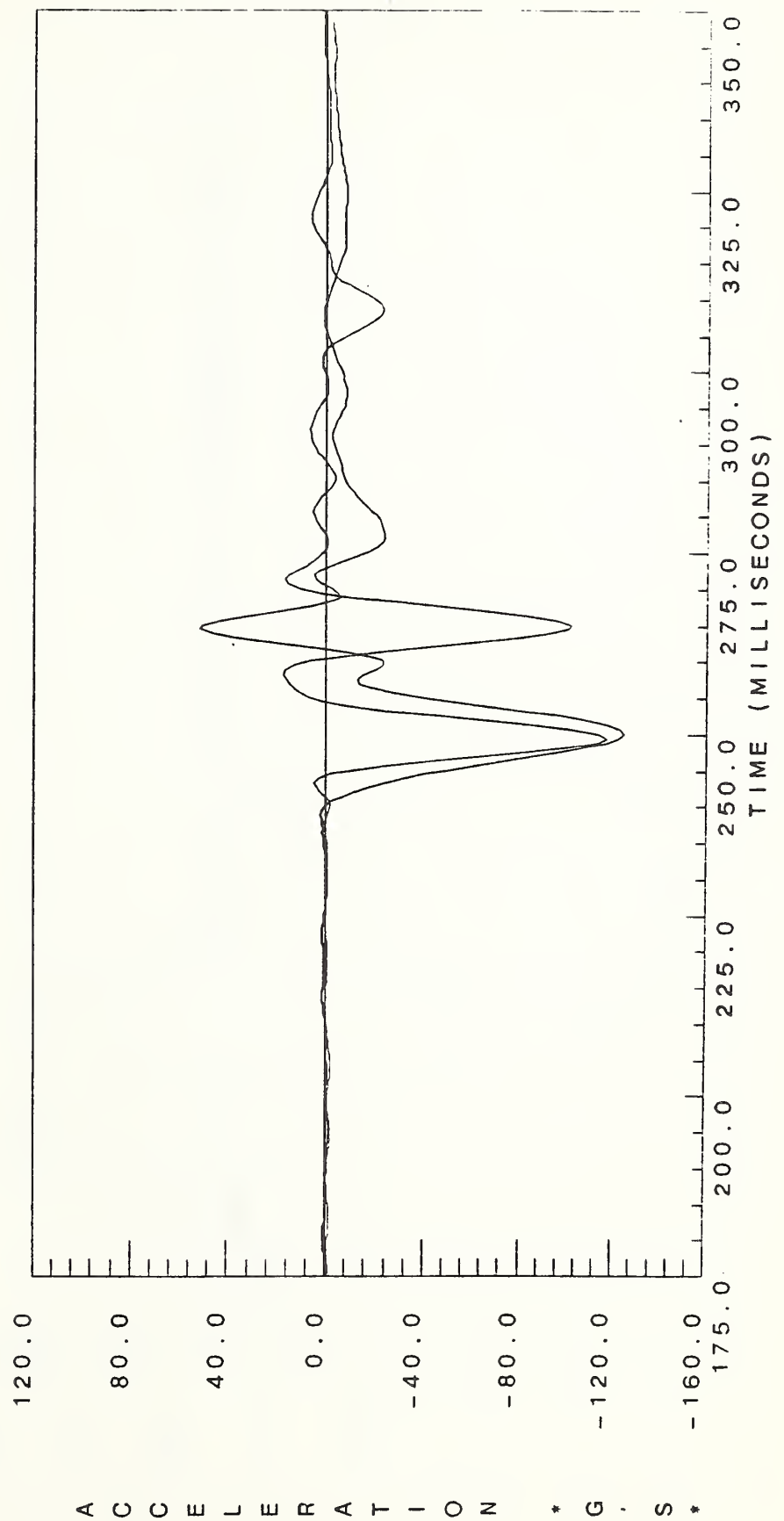
AIS - SEVERITY

Run No	Body Sur- face	Head	Thorax	Abdomen	Pelvis	Spine	Extrem .	MAIS
H 8021	0	0	0	0	0	1	0	1
H 8023	0	0	3	0	0	1	0	3
H 8111	0	0	0	0	0	2	0	2
H 8112	0	1	3	0	0	0	0	3
H 8115	0	0	0	0	0	1	0	1
H 8121	0	0	0	0	0	1	1	1
6	0	.2	1	0	0	1	.2	2

	6th RIB			7th RIB		
Run No	max. Force [N]	max. Defl. [mm]	Cross section [mm2]	max. Force [N]	max. Defl. [mm]	Cross section [mm2]
H 8021	-	-	-	-	-	-
H 8023	208	4.0	27.1	234	4.0	28.3
H 8111	210	2.4	25	198	6.1	23
H 8112	54.4	3.0	24.6	89.6	2.8	24.3
H 8115	197	4.6	25	219	2.5	33
H 8121	195	5.7	26	194	4.6	25
6	172.9	3.94	25.54	186.9	4	26.72

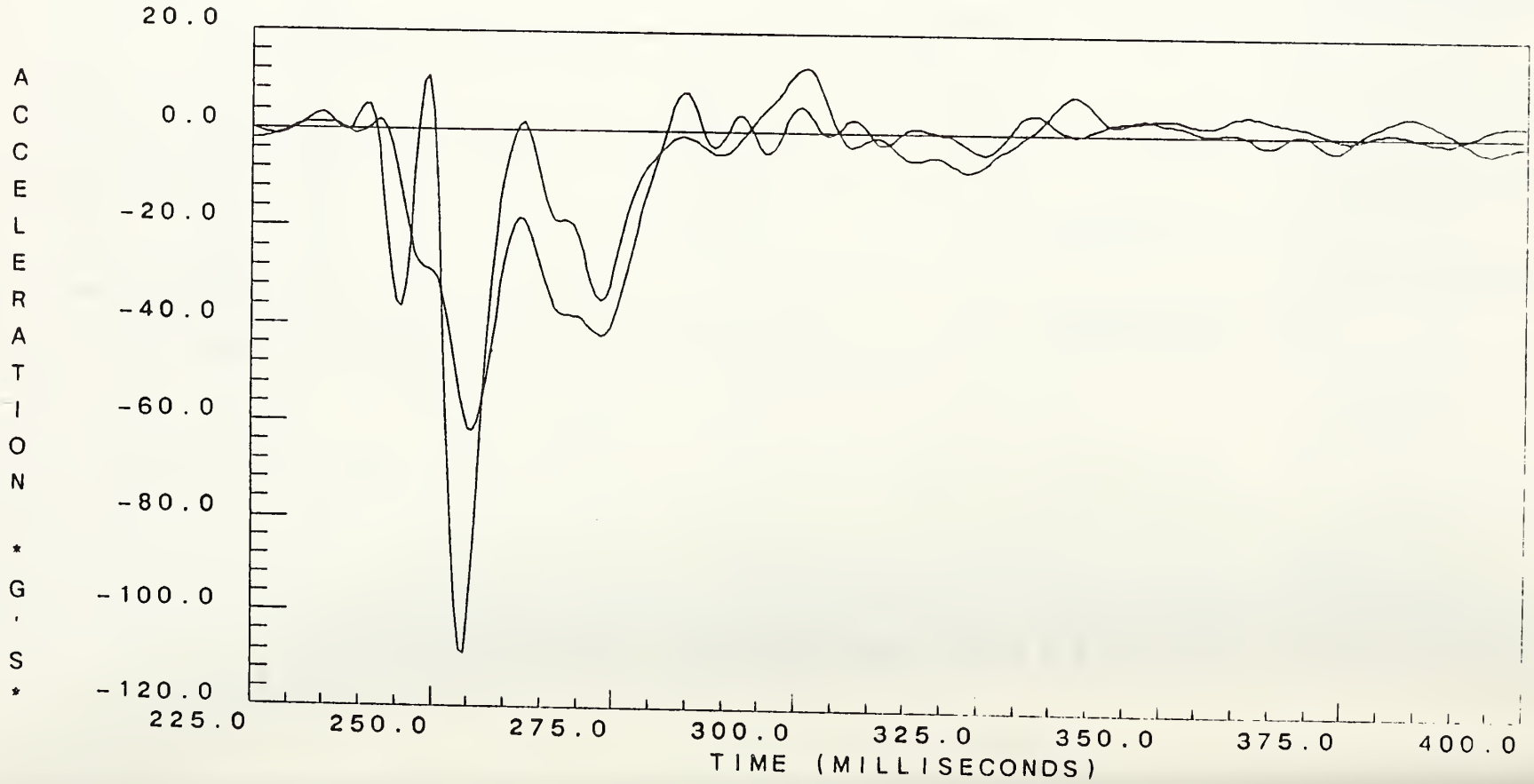
Side Impact

20 MPH HNCB, Upper Rib (Y)



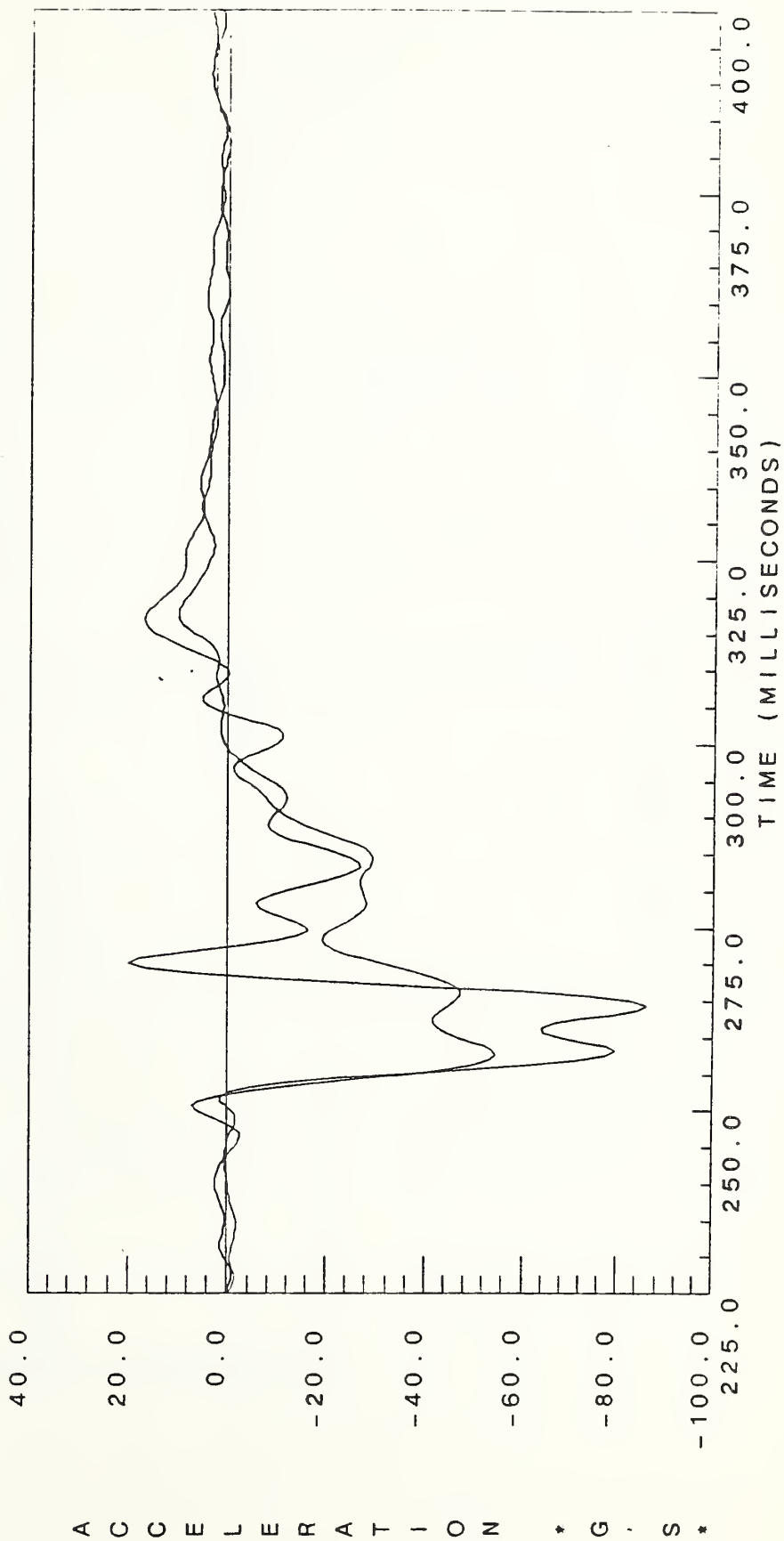
Side Impact

20 MPH HNCB, Upper Spine (Y)



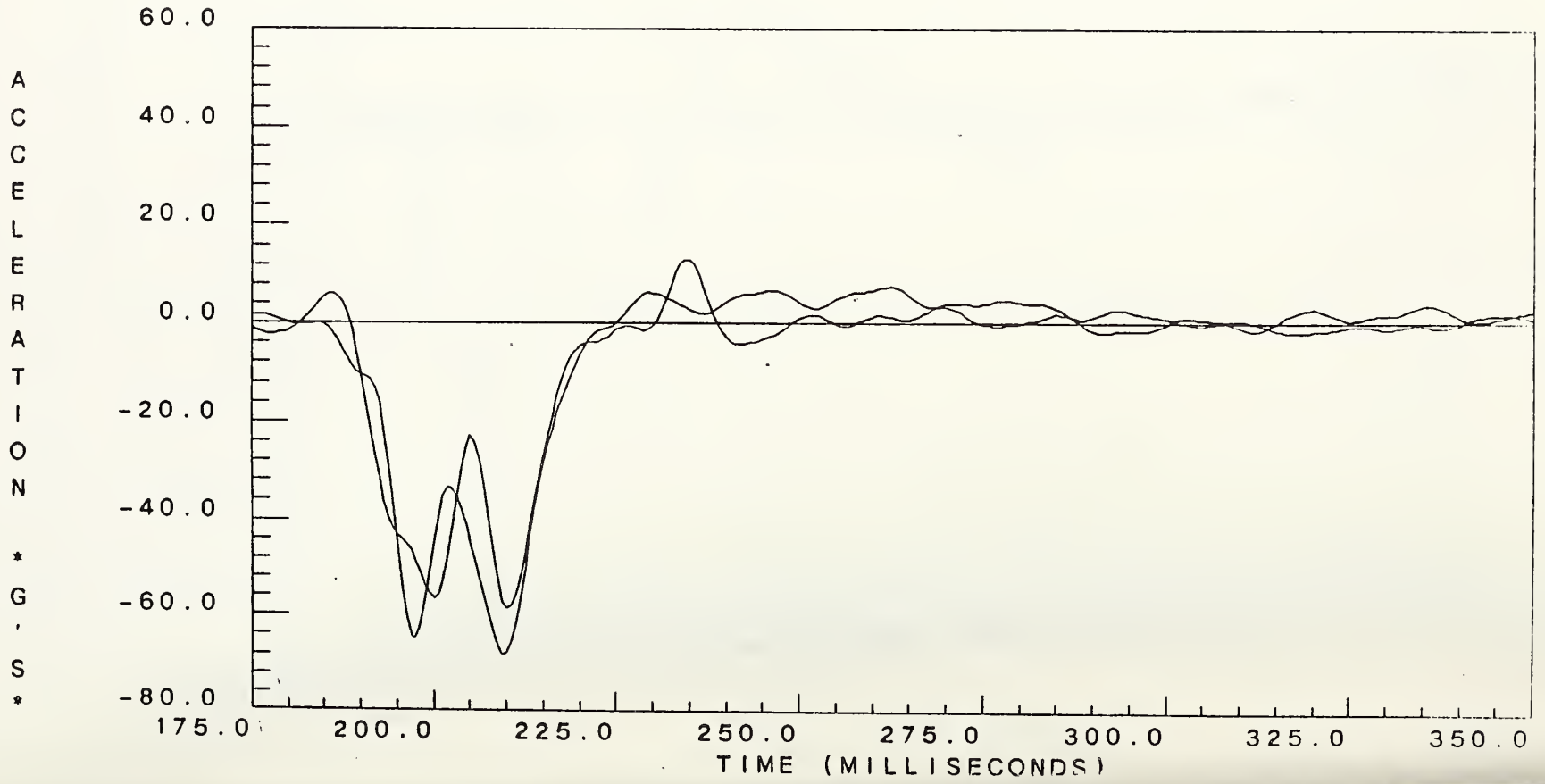
Side Impact

20 MPH HNCB, Lower Spine (Y)



Side Impact

20 MPH HNCB, Pelvis (Y)



Run No. H 80 021

a) Subject:

male, 29 years, body weight 63 kg, body length 180 cm, (further anthorpometric data s. incl.), cause of death: suffocation.

b) Test conditions:

Lateral collision - US padding -, impact velocity 32 km/h.

c) Instrumentation:

Sled deceleration, 9 accelerometer head, 12 accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface: No injuries
Head : No injuries
Thorax : No injuries
Abdomen : No injuries
Vertebral Column: Small hemorrhage under the posterior longitudinal Ligament from C 2 to C6.
Extremities: No injuries

e) Severity degree: AIS-head 0, AIS-thorax 0, AIS-Abdomen 0, AIS-Vertebral Column 1, AIS-Extremities 0, MAIS 1.

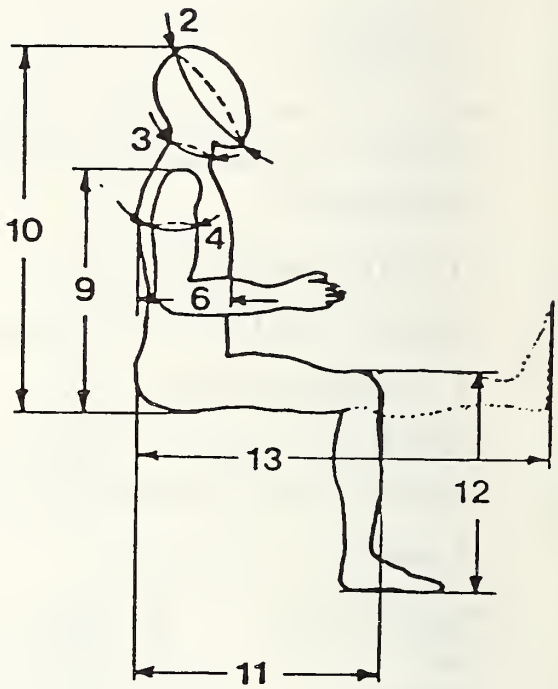
Run No. H 80 021

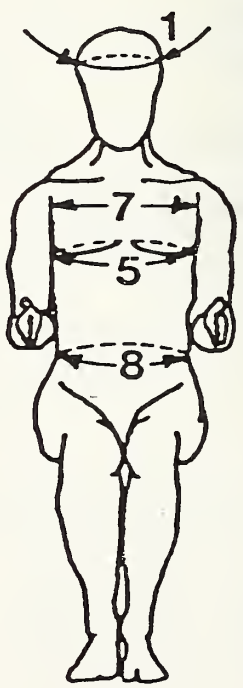
Anthropometrical Data

Body weight ....63 kg

Body length ....180 cm

1. Hat dimension .....56.....cm
2. Head circumference.....60.....cm
3. Neck circumfer. .....39.....cm
4. Upper arm circumfer. .....29.....cm
5. Chest circumfer. .....90.....cm
6. Chest height .....22.....cm
7. Chest width .....31.....cm
8. Abdomen circumfer. .....78.....cm
9. Buttocks - shoulder .....68.....cm
10. Seat height .....94.....cm
11. Pelvis - knee .....54.....cm
12. Sole of foot - knee .....50.....cm
13. Pelvis - heal .....98.....cm





I. Run No. H 80 023

a) Subject:
Female, 41 years, body weight 82 kg, body length 159 cm (further anthropometric data s. incl.), cause of death: lung artery embolism.

b) Test conditions:
Lateral collision - US padding - impact velocity 33 km/h.

c) Instrumentation:
Sled deceleration, 9 accelerometer head, 12 accelerometer thorax, 3 accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries
Head:	No injuries
Thorax:	Fracture of the 2nd to 9th rib, left in the forward axillar line; fracture of the 2nd to 4th rib, left in the paravertebral region (incl.)
Abdomen:	No injuries
Vertebral Column:	Small hemorrhage under the ligamentum posterius of the vertebral discs C2/C3
Extremities:	No injuries

e) Severity degree: AIS-Head 0, AIS-Thorax 3, AIS-Abdomen 0, AIS-Vertebral Column 1, AIS-Extremities 0, MAIS 3

BENDING TESTS

Run No. H 80 023	Max. Force (N)	Max. Deflection (mm)	Cross Section (mm^2)
6th rib	208	4,0	27,1
7th rib	234	4,0	28,3

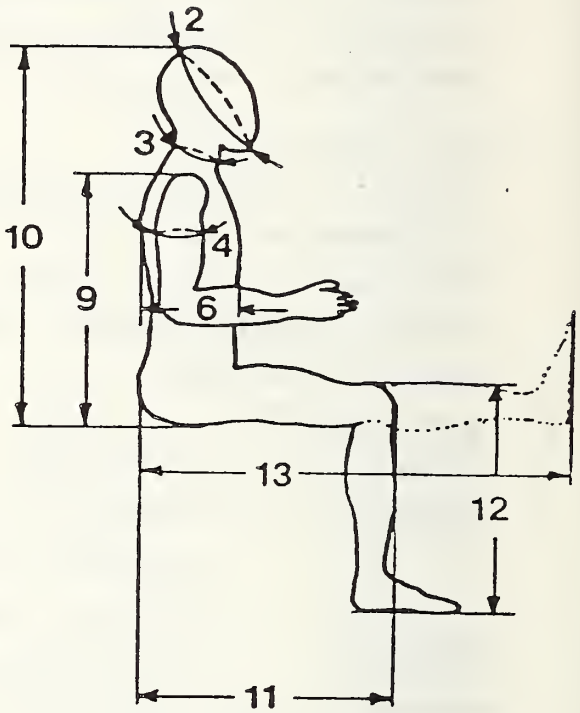
Run No. H 80 023

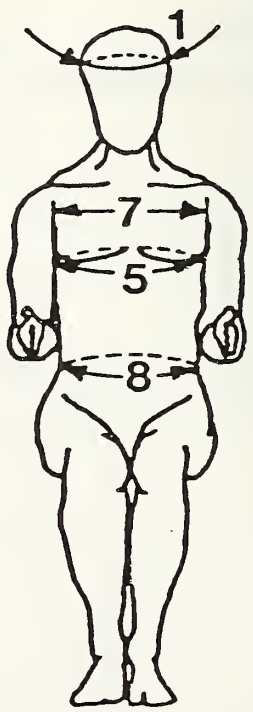
Anthropometrical Data

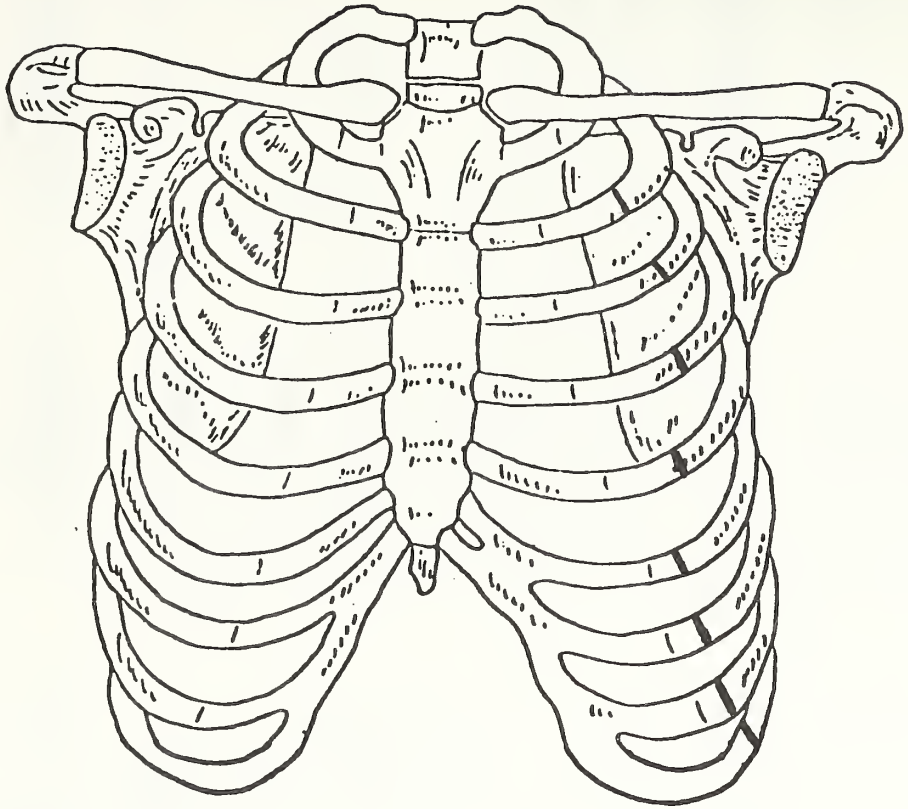
Body weight ..... 82 kg

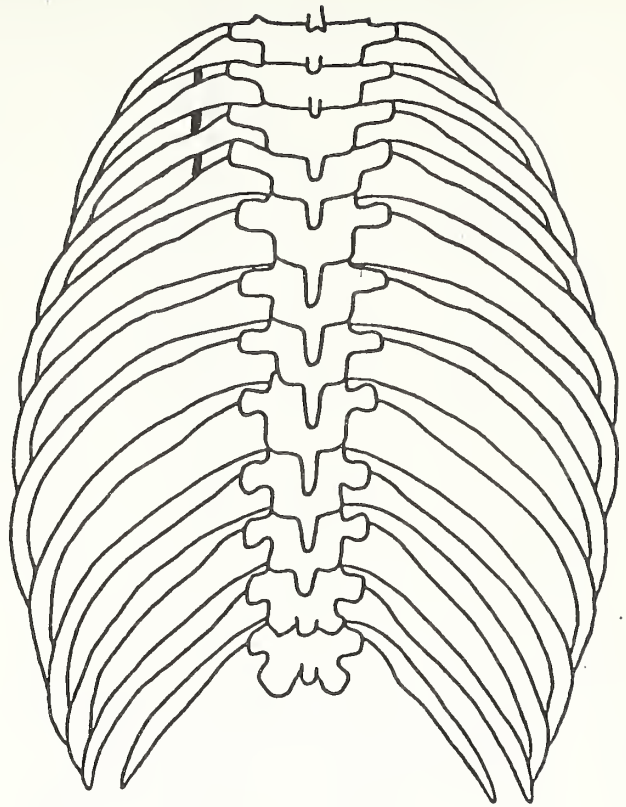
Body length ..... 159 cm

1. Hat dimension ..... 54 cm
2. Head circumference ..... 66 cm
3. Neck circumfer. ..... 40 cm
4. Upper arm circumfer. ..... 32 cm
5. Chest circumfer. ..... 94 cm
6. Chest height ..... 24 cm
7. Chest width ..... 33 cm
8. Abdomen circumfer. ..... 98 cm
9. Buttocks - shoulder ..... 71 cm
10. Seat height ..... 94 cm
11. Pelvis - knee ..... 55 cm
12. Sole of foot - knee ..... 49 cm
13. Pelvis - heal ..... 90 cm









Number of rib fractures 11

Run No. H 81 011

a) Subject:
Male, 43 years, Body weight: 59 kg, Body length: 165 cm (further anthropometric data s. incl.), cause of death: cardial infarct.

b) Test conditions:
Lateral collision - US-padding - impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	No injuries.
Abdomen:	No injuries.
Vertebral Column:	Hemorrhage in the medium and deep muscular layer from C5 to Th3 right; in the left side between Th1 and Th2 laceration of the ligamentum flavum Th1/Th2. Hemorrhage in the vertebral discs C3/C4/C5/C6. Interspinal hemorrhages by C4/C5/C6.
Extremities:	No injuries.
e) Severity Degree:	AIS-head 0, AIS-thorax 0, AIS-abdomen 0, AIS-vertebral column 2, AIS-extremities 0, MAIS 2.

BENDING TESTS

Run No. H 81 011

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	210	2,4	25
7th rib	198	6,1	23

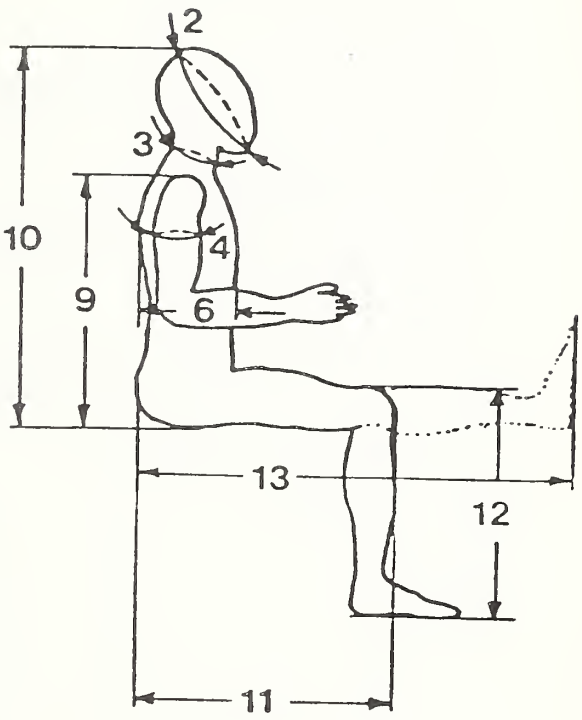
Run No. H 81 o11

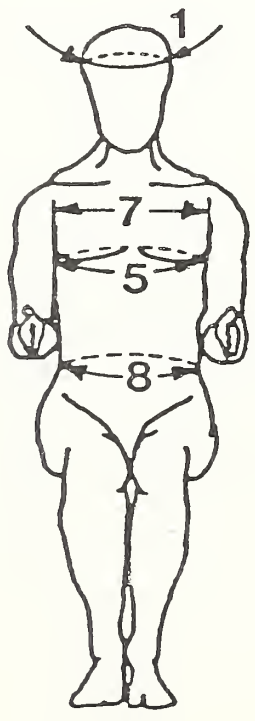
Anthropometrical Data

Body weight ....59.... kg

Body length ....165.... cm

1. Hat dimension .....55.....cm
2. Head circumference.....62.....cm
3. Neck circumfer. .....41.....cm
4. Upper arm circumfer. .....26.....cm
5. Chest circumfer. .....87.....cm
6. Chest height .....22.....cm
7. Chest width .....28.....cm
8. Abdomen circumfer. .....81.....cm
9. Buttocks - shoulder .....63.....cm
10. Seat height .....85.....cm
11. Pelvis - knee .....52.....cm
12. Sole of foot - knee .....51.....cm
13. Pelvis - heal .....95.....cm





Run No. 81 012

a) Subject:
Female, 33 years, body weight 46 kg, body length 156cm (further anthropometric data s. incl.), cause of death: asphyxia.

b) Test conditions:
Lateral collision, US padding, impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	Hemorrhage in the scalp.
Thorax:	Fracture of 2nd rib left in the rear axillar line, fracture of 3rd rib left in the medium axillar line and in the cartilage-bone transition; fracture of 4th and 5th rib left in the medio clavicular line. Fracture of sternum in the level of 4th ribs (incl.).
Abdomen:	No injuries.
Vertebral Column:	No injuries.
Extremities:	No injuries.
e) AIS Severity:	Head-1, Thorax-3, Abdomen-0, Vertebral Column-0, Extremities-0, MAIS-3.

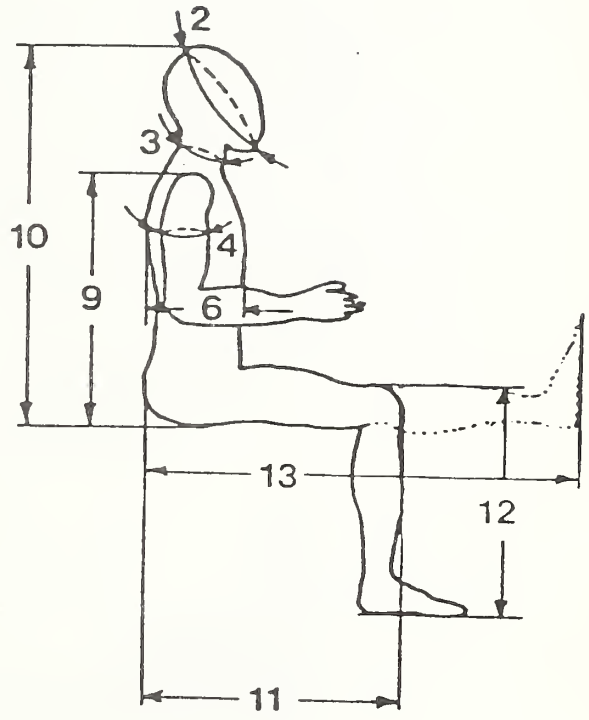
Run No. H 81 o12

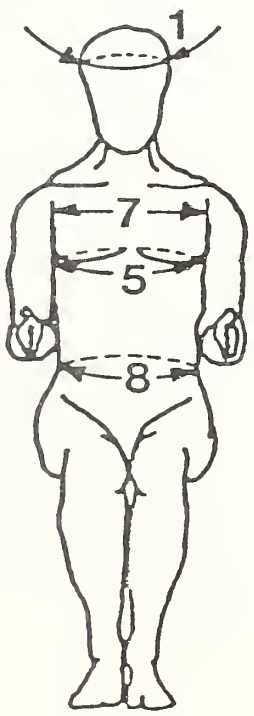
Anthropometrical Data

Body weight ..46.. kg

Body length ..156.. cm

1. Hat dimension .....54.....cm
2. Head circumference.....57.....cm
3. Neck circumfer. .....33.....cm
4. Upper arm circumfer. .....27.....cm
5. Chest circumfer. .....74.....cm
6. Chest height .....18.....cm
7. Chest width .....26.....cm
8. Abdomen circumfer. .....72.....cm
9. Buttocks - shoulder .....63.....cm
10. Seat height .....82.....cm
11. Pelvis - knee .....53.....cm
12. Sole of foot - knee .....44.....cm
13. Pelvis - heal .....9o.....cm





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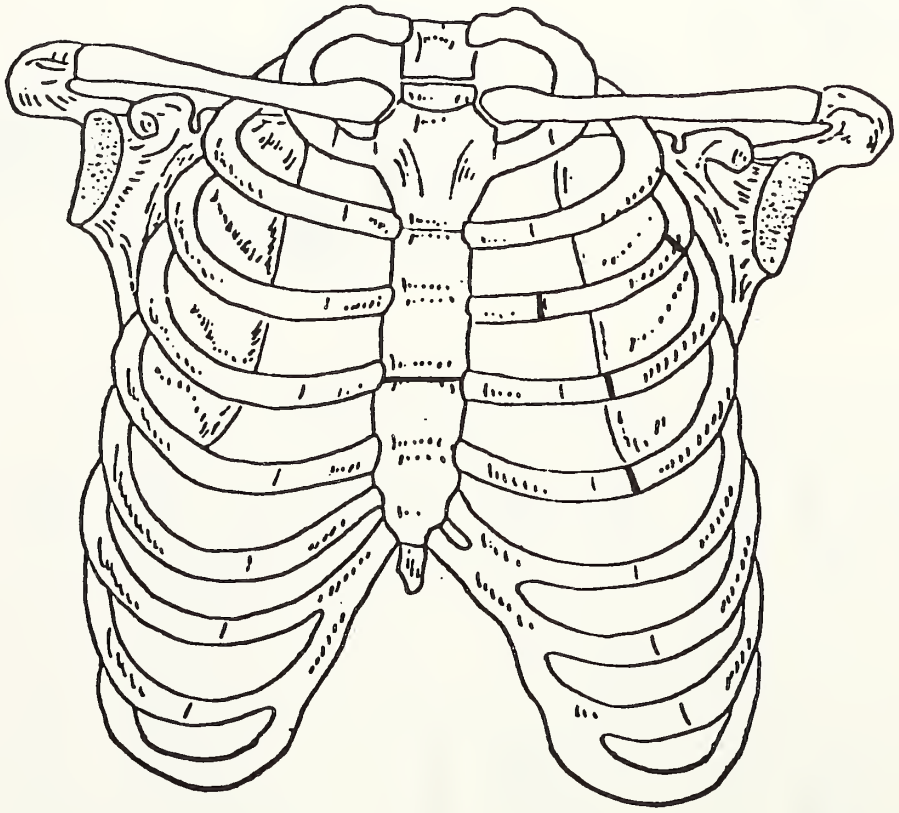
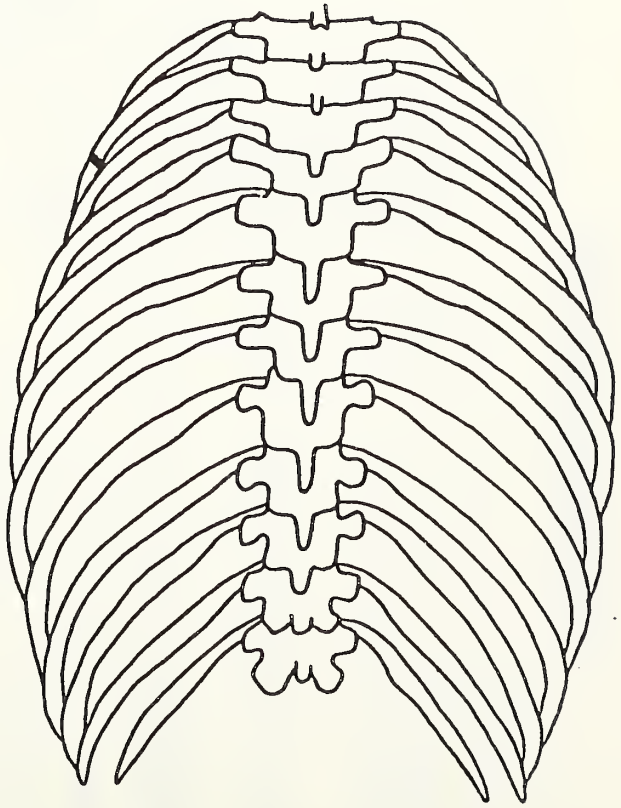
Run No. H 81 12 DOT





Number of rib fractures 5

Run No. H81015

a) Subject:
Male, 44 years, body weight 73 kg, body length 172 cm (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, US-padding*, impact velocity 23 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	No injuries.
Abdomen:	No injuries.
Vertebral column:	Hemorrhage in the medium and deep muscle layer between C5 and Th3. Hemorrhage of the scalenus muscle left.
Extremities:	No injuries.
e) AIS Severity:	Body surface 0, Head 0, Thorax 0, Abdomen 0, Vertebral Column 1, Extremities 0, MAIS 1.

BENDING TESTS

Run No. H81015

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	197	4,6	25
7th rib	219	2,5	33

*US-Padding = HNCB

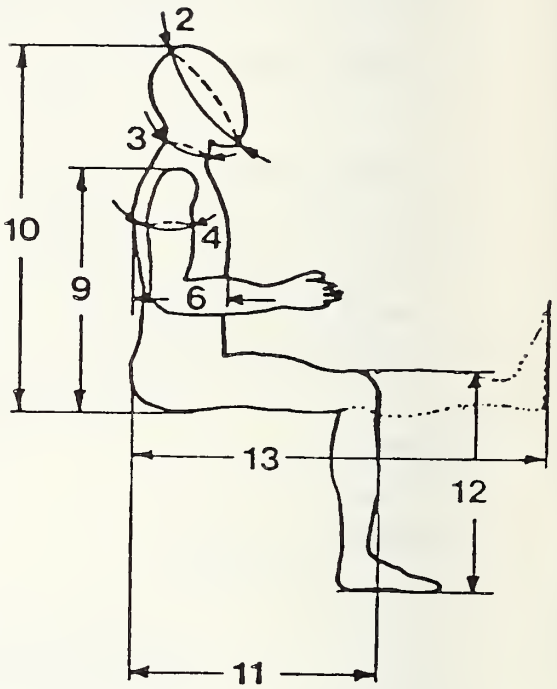
Run No. H 81 o15

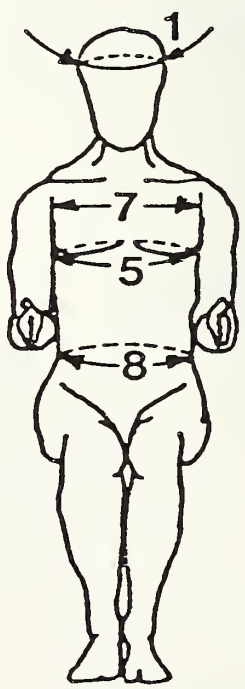
Anthropometrical Data

Body weight ...73 kg

Body length ...172 cm

1. Hat dimension .....52.....cm
2. Head circumference.....7o.....cm
3. Neck circumfer. .....34.....cm
4. Upper arm circumfer. .....28.....cm
5. Chest circumfer. .....92.....cm
6. Chest height .....23.....cm
7. Chest width .....32.....cm
8. Abdomen circumfer. .....82.....cm
9. Buttocks - shoulder .....7o.....cm
10. Seat height .....91.....cm
11. Pelvis - knee .....55.....cm
12. Sole of foot - knee .....51.....cm
13. Pelvis - heal .....96.....cm





Run No. H81021

a) Subject:
Female, 48 years, body weight 57 kg, body length 166 cm (further anthropometric data s. incl.), cause of death: heart failure.

b) Test conditions:
Lateral collision, US-padding, impact velocity 24 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	No injuries.
Abdomen:	No injuries.
Vertebral column:	Hemorrhage in the vertebral disc C5/C6 and interspinal space C5/C6.
Extremities:	Hemorrhage in the delta muscle of the left upper arm.
e) AIS Severity:	Body surface 0, Head 0, Thorax 0, Abdomen 0, Vertebral Column 1, Extremities 1, MAIS 1.

BENDING TESTS

Run No. H81021	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	195	5,7	26
7th rib	194	4,6	25

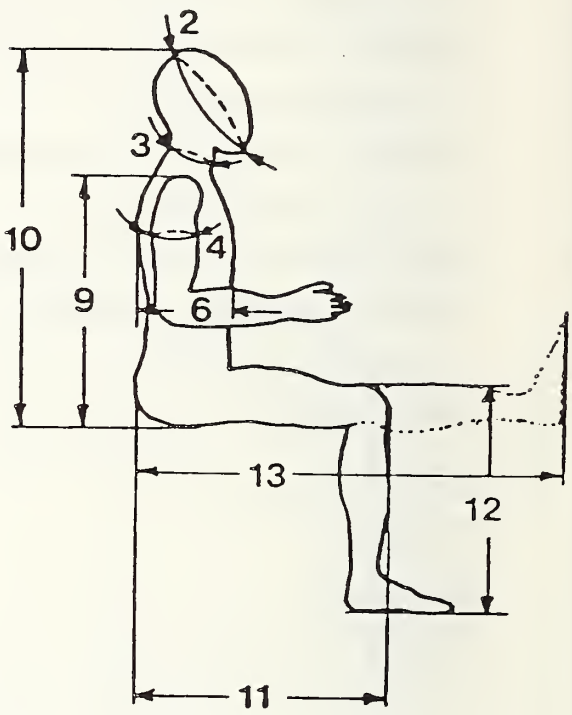
Run No. H 81 o21

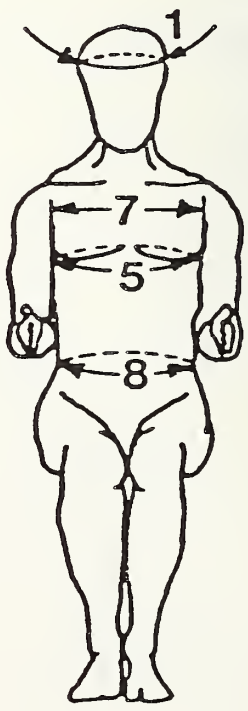
Anthropometrical Data

Body weight ..... 57 kg

Body length ..... 166 cm

1. Hat dimension ..... 54 cm
2. Head circumference ..... 62 cm
3. Neck circumfer. ..... 32 cm
4. Upper arm circumfer. ..... 24 cm
5. Chest circumfer. ..... 82 cm
6. Chest height ..... 21 cm
7. Chest width ..... 28 cm
8. Abdomen circumfer. ..... 81 cm
9. Buttocks - shoulder ..... 65 cm
10. Seat height ..... 87 cm
11. Pelvis - knee ..... 54 cm
12. Sole of foot - knee ..... 5o cm
13. Pelvis - heal ..... 93 cm





APPENDIX V

LATERAL IMPACT CADAVER TESTS INTO A WALL WITH APR PAD.

IMPACT VELOCITY :

32 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8018	male	21	61	186	58	63	37	27	38
H 8020	female	26	67	167	57	66	36	25	80
H 8208	male	61	99	172	56	70	47	35	108
H 8221	male	48	99	180	55	63	44	31	106
H 8222	male	50	77	167	55	64	38	28	95
5	M 4 F 1	41.2	80.6	170.4	56.2	65.2	40.4	29.2	85.4

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8018	23	30	75	69	90	57	50	96
H 8020	19	28	75	72	85	57	48	93
H 8208	28	38	113	75	98	57	54	98
H 8221	26	36	102	73	94	61	56	106
H 8222	22	33	85	72	93	55	52	86
5	23.6	33	90	72.2	94	57.4	52	95.8

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8018	APR pad	31	0	0	0	0	0	0	0
H 8020	APR pad	30	3	3	0	3	0	0	0
H 8208	APR pad	31	18	15	7	8	3	2	1
H 8221	APR pad	32	25	21	9	12	4	1	3
H 8222	APR pad	32	25	20	5	15	5	2	3
5	APR pad	31.2	14	12	4.2	7.6	2.4	1	1.4

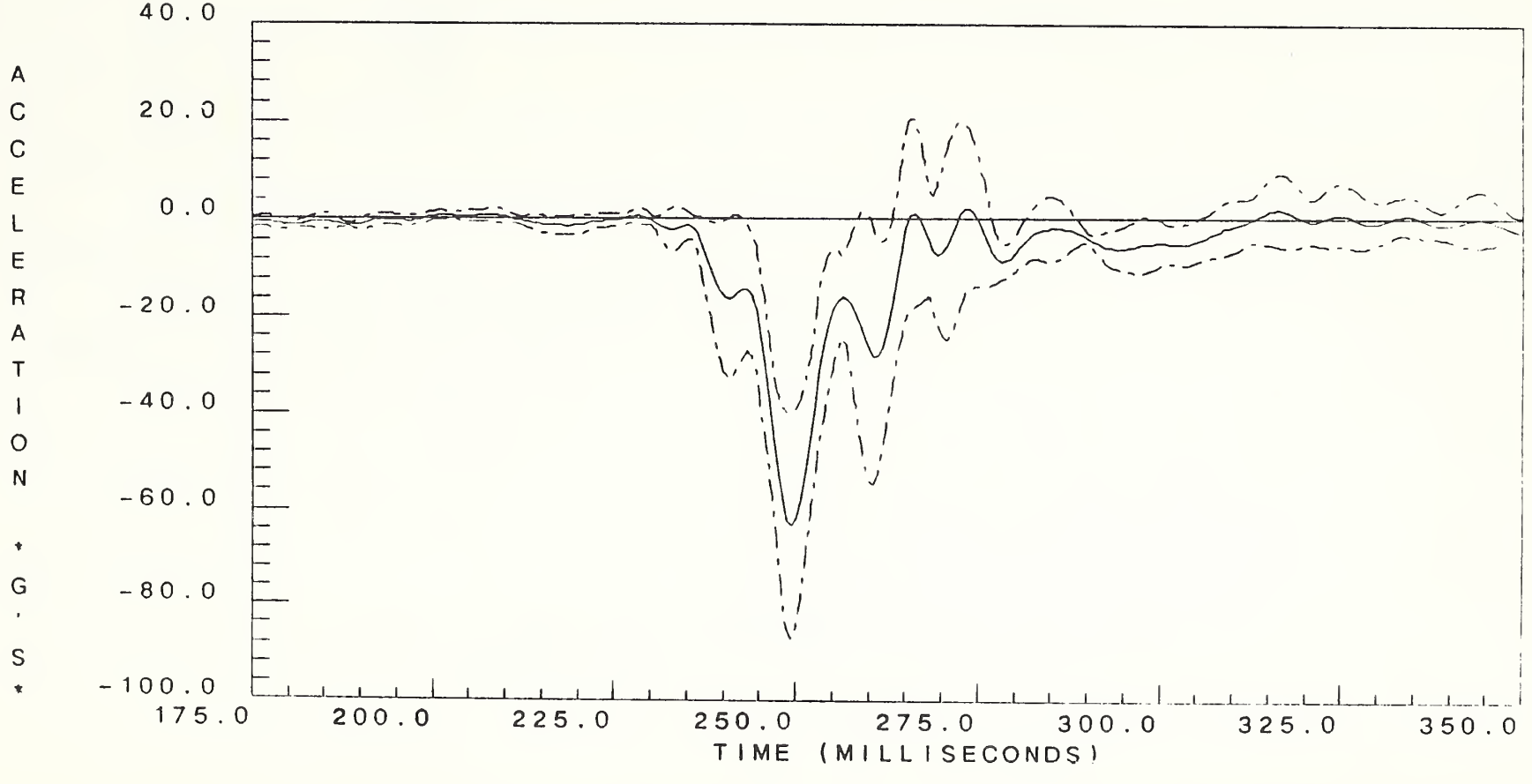
AIS - SEVERITY

Run No	Body Sur-face	Head	Thorax	Abdomen	Pelvis	Spine	Extrem .	MAIS
H 8018	0	3	3	0	0	1	0	3
H 8020	0	0	1	0	0	1	0	1
H 8208	0	0	0	4	5	4	2	5
H 8221	0	0	4	0	0	1	0	4
H 8222	0	0	4	5	0	2	0	5
5	0	.6	2	2	1	2	.4	4

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
H 8018	-	-	-	-	-	-
H 8020	-	-	-	-	-	-
H 8208	104	2.0	27.0	-	-	-
H 8221	-	-	-	-	-	-
H 8222	138	3.15	28.6	158	3.4	27.9
5	121	2.58	27.8	158	3.4	27.9

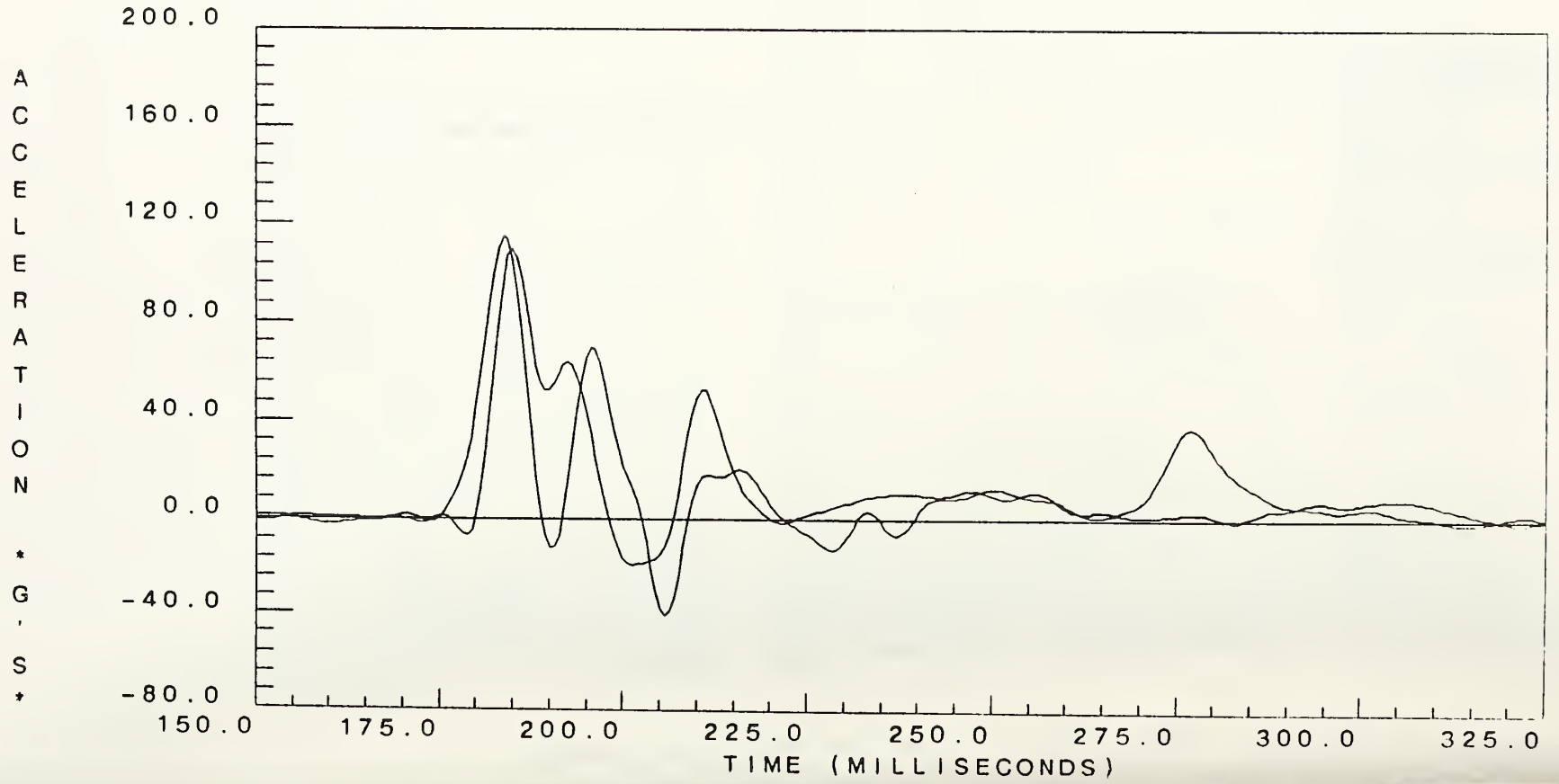
Mean Response with +/- 1 St. Dev. Corridor

20 MPH APR Padding, Upper Rib (Y)



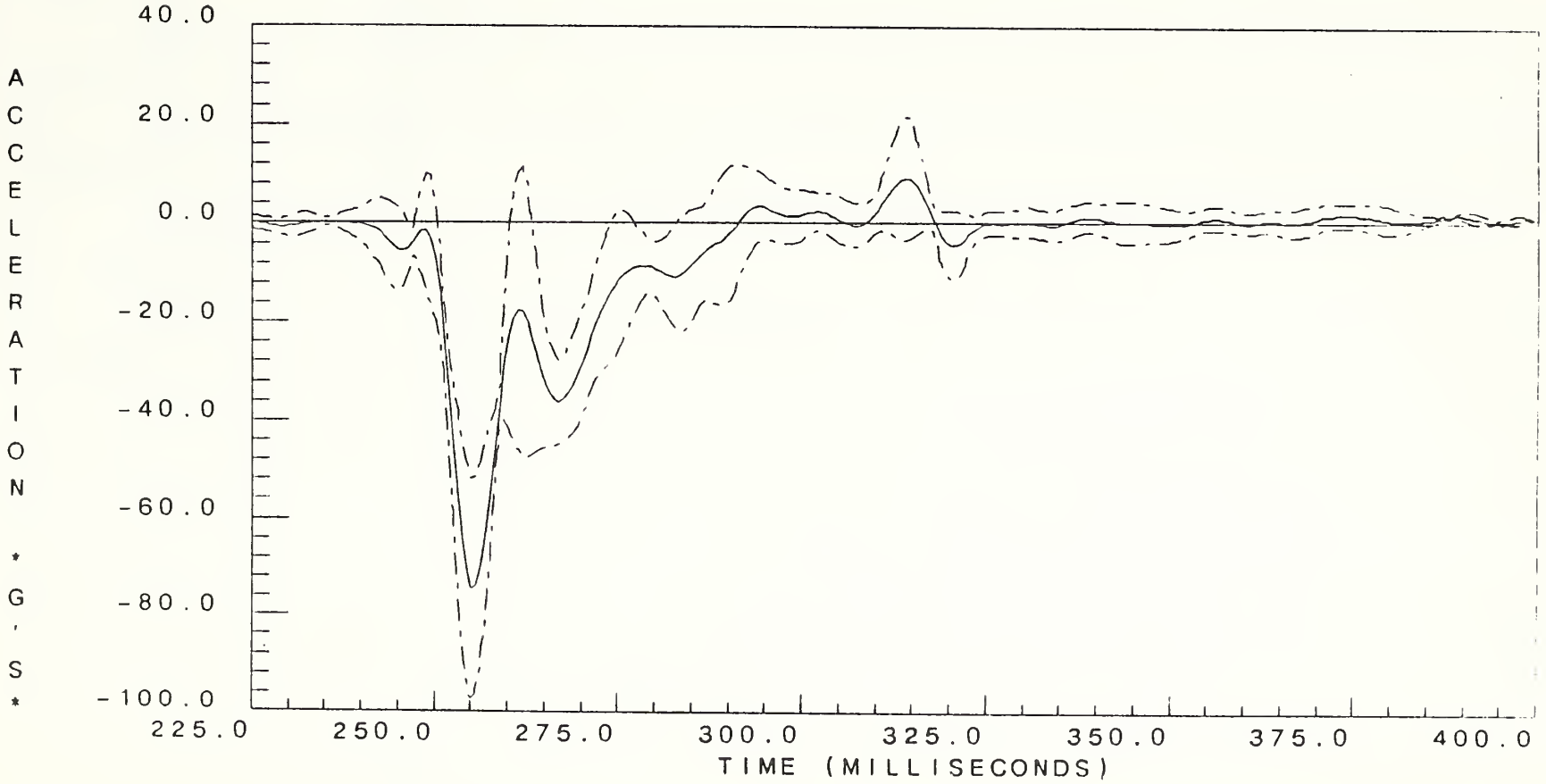
Side Impact

20 MPH APR Padding, Lower Rib (Y)



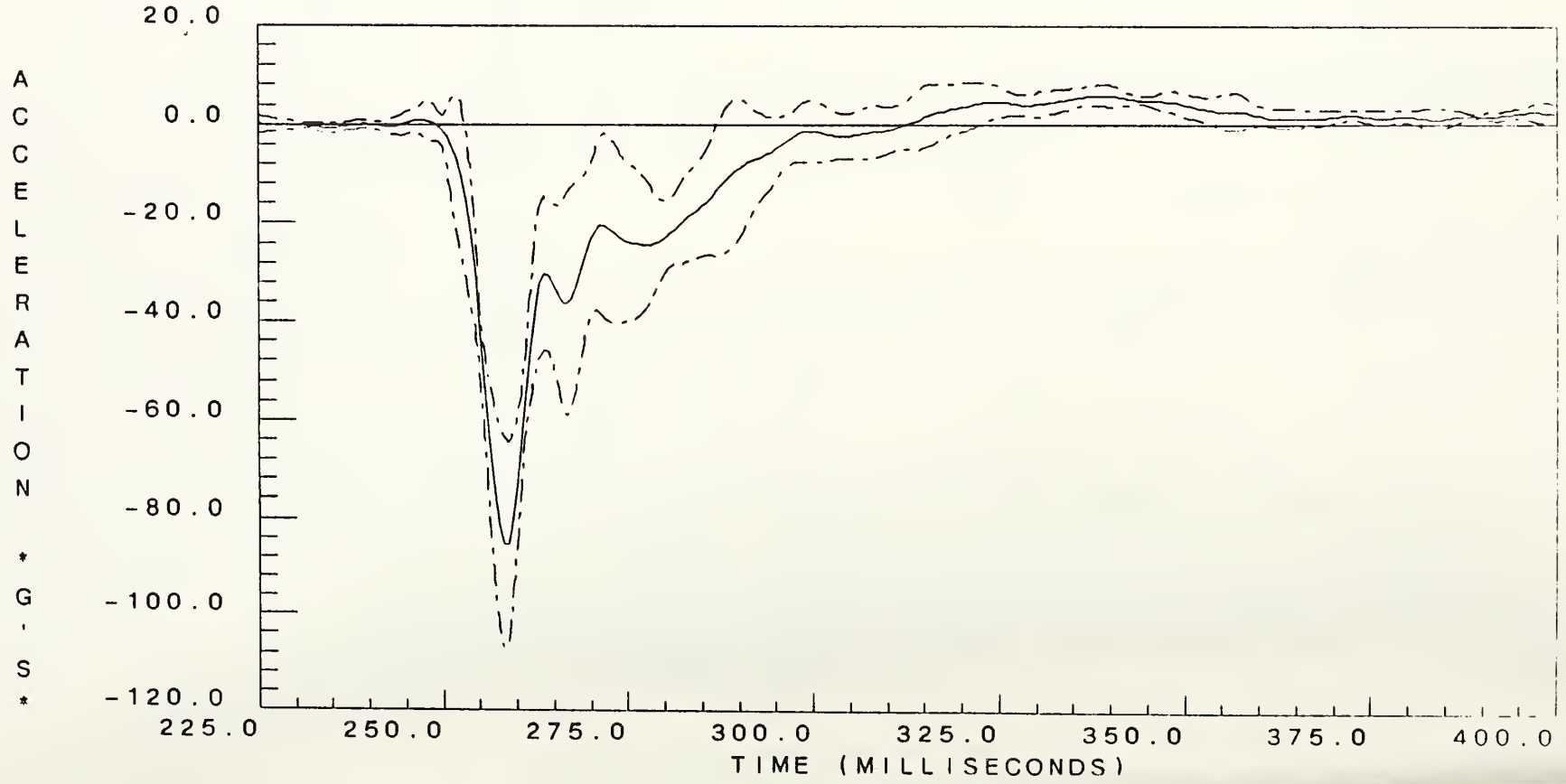
Mean Response with +/- 1 St. Dev. Corridor

20 MPH APR Padding, Upper Spine (Y)



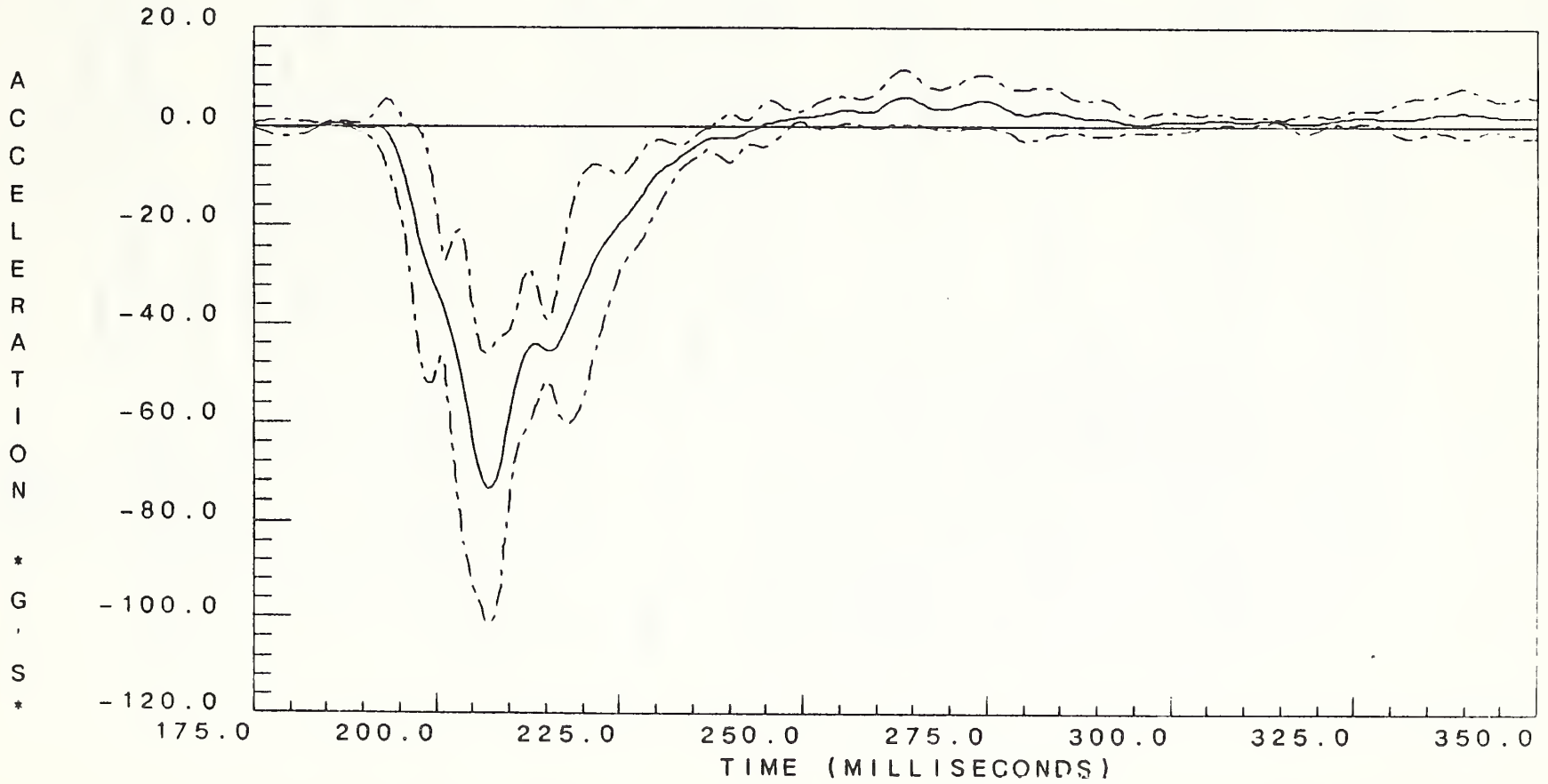
Mean Response with +/- 1 St. Dev. Corridor

20 MPH APR Padding, Lower Spine (Y)



Mean Response with +/- 1 St. Dev. Corridor

20 MPH APR Padding, Pelvis Acc. (Y)



Run No. H 80 0 18

a) Subject:

Male, 21 years, body weight 61 kg, body length 166 cm, (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions:

Lateral collision - APR pad -, impact velocity 31 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 2-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	y-shaped, 3cm long contusion in the range of the left eyebrow. Abrasion (6 x 6cm) on the back side of the left shoulder.
Head:	Fracture of the nasal bone; impression fracture of the left skull base.
Thorax:	No injuries.
Abdomen:	No injuries.
Vertebral Column:	Hemorrhage and subluxation of the right vertebral joint Th3/Th4; hemorrhage of the foramen intervertebral Th3/Th4. Hemorrhage in the frontal epidural space from occiput to C7.
Extremities:	No injuries.

e) Severity degree: AIS head 3, AIS thorax 0, AIS abdomen 0, AIS vertebral column 1, MAIS 3.

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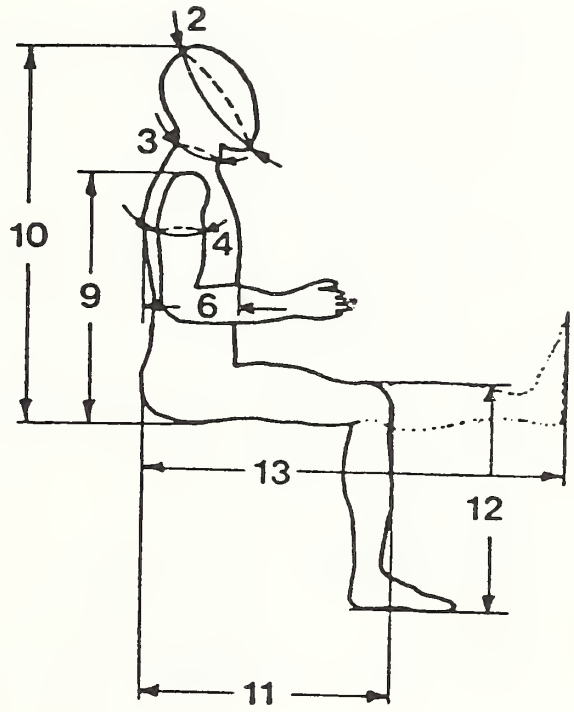
Run No. H 8o o18

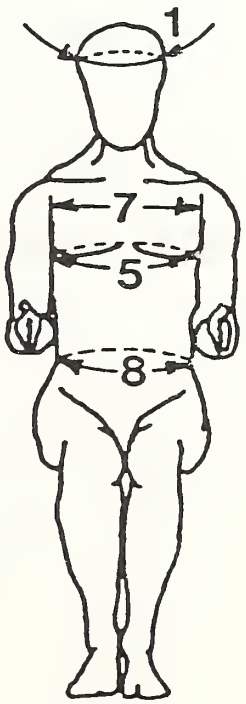
Anthropometrical Data

Body weight ....61 kg

Body length ....166 cm

1. Hat dimension .....58.....cm
2. Head circumference.....63.....cm
3. Neck circumfer. .....37.....cm
4. Upper arm circumfer. .....27.....cm
5. Chest circumfer. .....38.....cm
6. Chest height .....23.....cm
7. Chest width .....3o.....cm
8. Abdomen circumfer. .....75.....cm
9. Buttocks - shoulder .....69.....cm
10. Seat height .....9o.....cm
11. Pelvis - knee .....57.....cm
12. Sole of foot - knee .....5o.....cm
13. Pelvis - heal .....96.....cm





Run No. H 80 020

a) Subject:

Female, 26 years, body weight 67 kg, body length 167 cm (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions:

Lateral collision - APR padding, impact velocity 30 km/h.

c) Instrumentation:

Sled deceleration, 9 accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure

d) Medical findings:

Body surface: No injuries
Head: No injuries
Thorax: Muscle hemorrhage left from the scapula area to the delta muscle. Hemorrhage in the musculus supraspinatus left. Fracture of the 7th, 8th and 12th rib left paravertebrall (incl.).

Abdomen: Fat tissue contusion and hemorrhage left at the Spina iliaca ant.-sup.

Vertebral Column: Hemorrhages in all muscle layers between C 6 and Th4. Dorsal epidural bleeding from C 7 to Th 5.

Extremities: No injuries

e) Severity degree : AIS-head 0, AIS-thorax 1, AIS-Abdomen 0, AIS-Vertebral Column 1, AIS-Extremities 0, MAIS 1

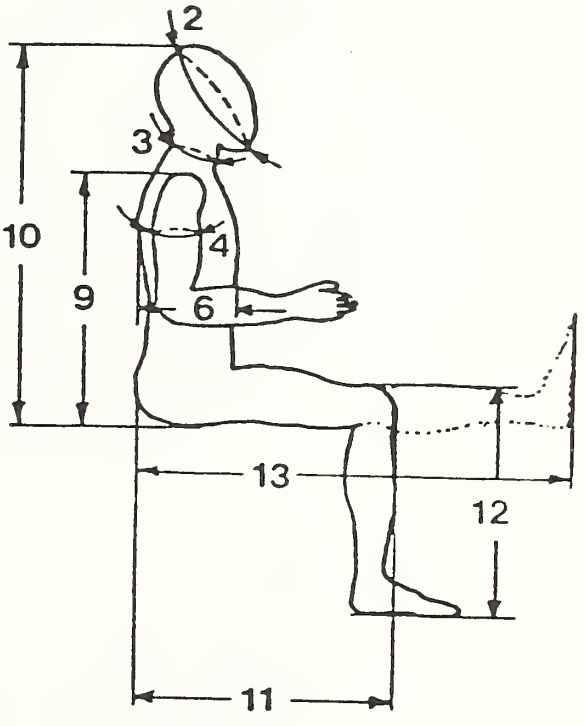
Run No. H 80 020

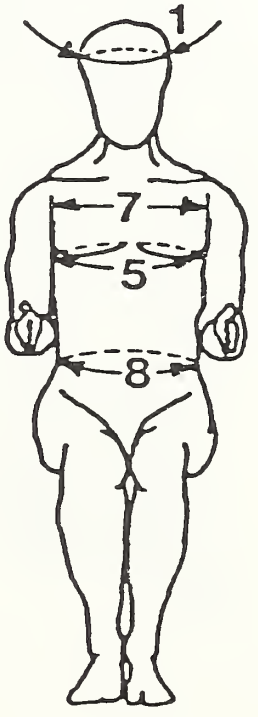
Anthropometrical Data

Body weight ..... 67 kg

Body length ..... 167 cm

1. Hat dimension ..... 57 cm
2. Head circumference ..... 66 cm
3. Neck circumfer. ..... 36 cm
4. Upper arm circumfer. ..... 25 cm
5. Chest circumfer. ..... 80 cm
6. Chest height ..... 19 cm
7. Chest width ..... 28 cm
8. Abdomen circumfer. ..... 75 cm
9. Buttocks - shoulder ..... 72 cm
10. Seat height ..... 95 cm
11. Pelvis - knee ..... 57 cm
12. Sole of foot - knee ..... 48 cm
13. Pelvis - heal ..... 93 cm





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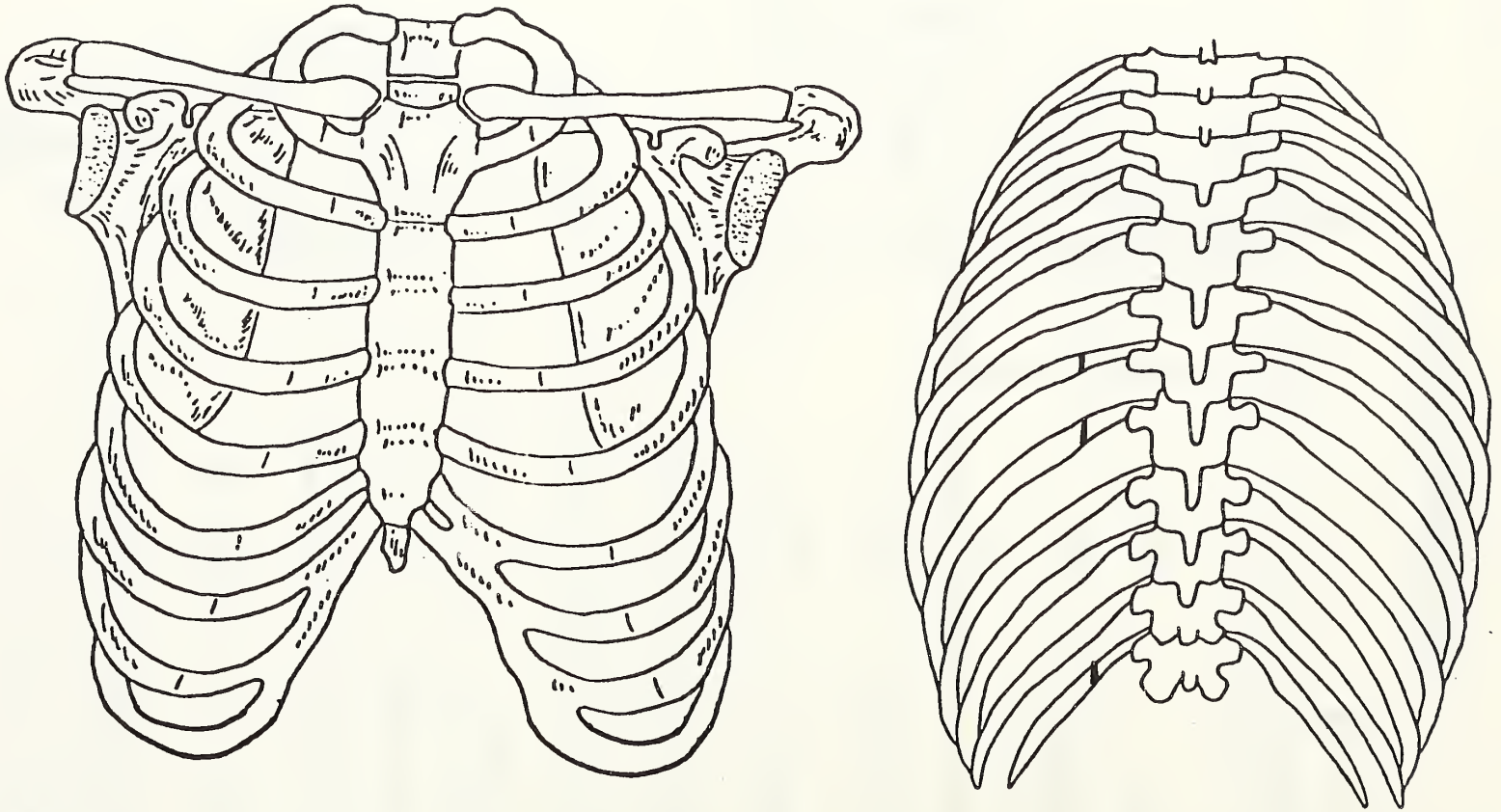
Run No. H 80 20 DOT



Number of rib fractures 3

Run No. H 8208

a) Subject:
Male, 61 years, body weight 99 kg, body length 172 cm (further anthropometric data s. incl.), cause of death: drown

b) Test conditions:
Lateral collision, APR-Padding, impact velocity 31 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Frac-ture of the 3d and 5th rib right in the front axillar line, fracture of the 10th rib right in the paravertebral region. Fracture of the 3d to 9th rib left in the scapula line and in the front axillar line. Fracture of the 10th rib in the medium axillar line (incl.)
Abdomen:	Rupture of the liver, 5 cm long.
Vertebral Column:	Laceration of the ligamentum anterius between C 5 and C 6. Multiple fracture of the 10th thoracic vertebral body. Fracture of the left upper corner of the 11th thoracic vertebral body. Laceration of the ligamentum anterius in this area. Segment

separation of Th 10. Fracture of the processus spinosus of Th 10. Luxation fracture of the vertebral joints Th 10. Fracture in the spinal osteochondrosis C 5 / C 6. Laceration in the vertebral disc C 5 / C 6. Ventral laceration in the vertebral disc Th 1 / Th 2. Hemorrhage in the interspinal space Th 1 / Th 2. Fracture of the occiput joint condylus left.

Extremities: Mid-shaft fracture of the humerus left. Hemorrhages and lacerations in this area.

e) AIS- Severity: Body surface 0, head 0, thorax 4, abdomen 5, vertebral column 4, extremities 2, MAIS 5.

BENDING TESTS

Run No. H 8208

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	104	2	27
7th rib	was broken during the crash		

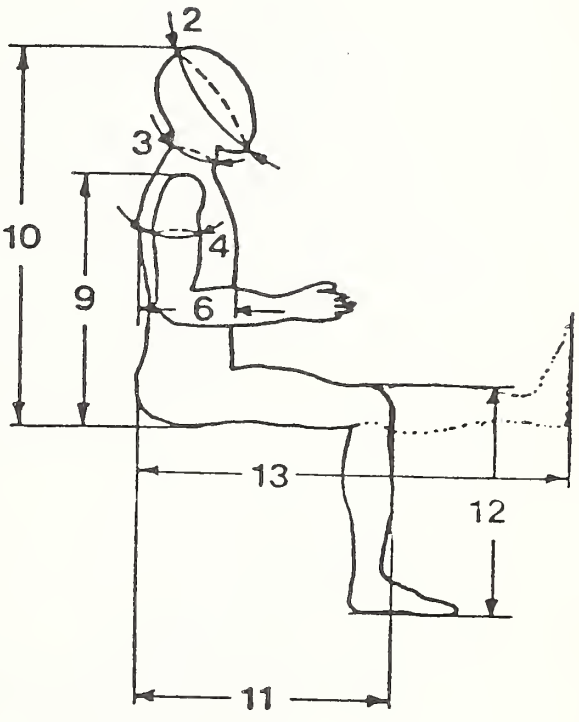
Run No. H 82 08

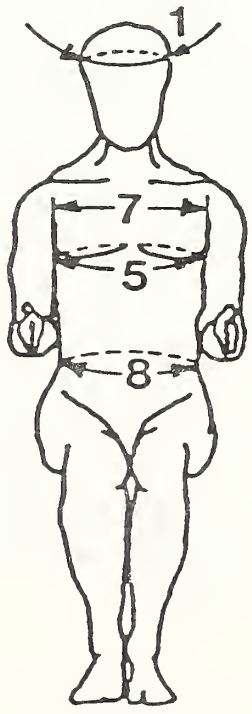
Anthropometrical Data

Body weight ..... 99 kg

Body length ..... 172 cm

1. Hat dimension ..... 56 ..cm
2. Head circumference..... 7o ..cm
3. Neck circumfer. ..... 47 ..cm
4. Upper arm circumfer. ..... 35 ..cm
5. Chest circumfer. ..... 1o8 ..cm
6. Chest height ..... 28 ..cm
7. Chest width ..... 38 ..cm
8. Abdomen circumfer. ..... 113 ..cm
9. Buttocks - shoulder ..... 75 ..cm
10. Seat height ..... 98 ..cm
11. Pelvis - knee ..... 57 ..cm
12. Sole of foot - knee ..... 54 ..cm
13. Pelvis - heal ..... 98 ..cm





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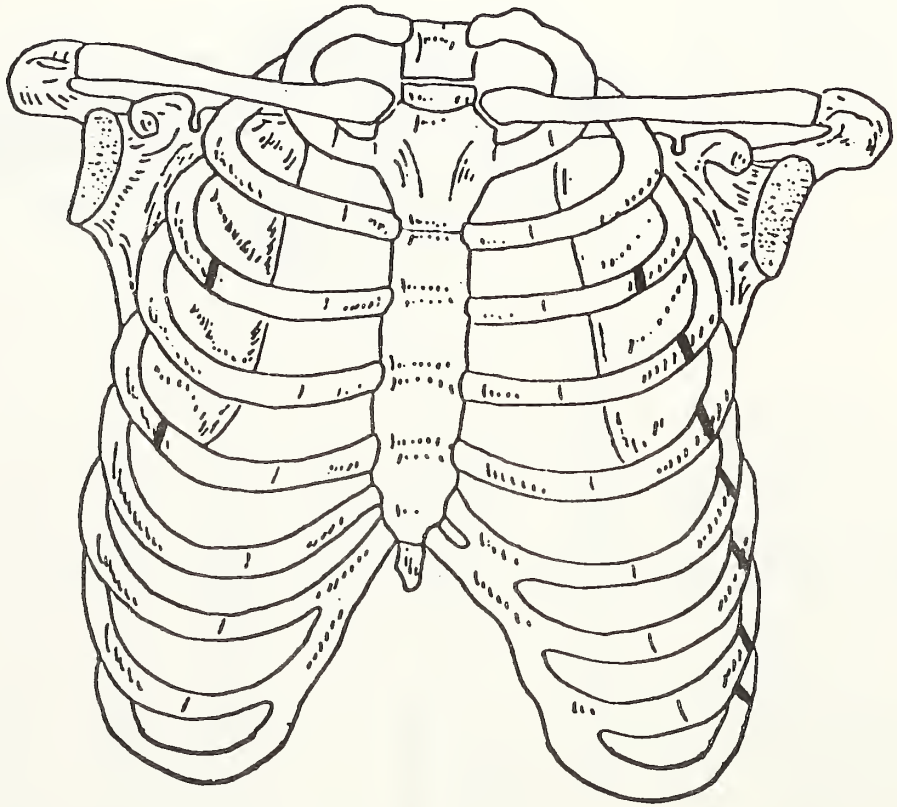
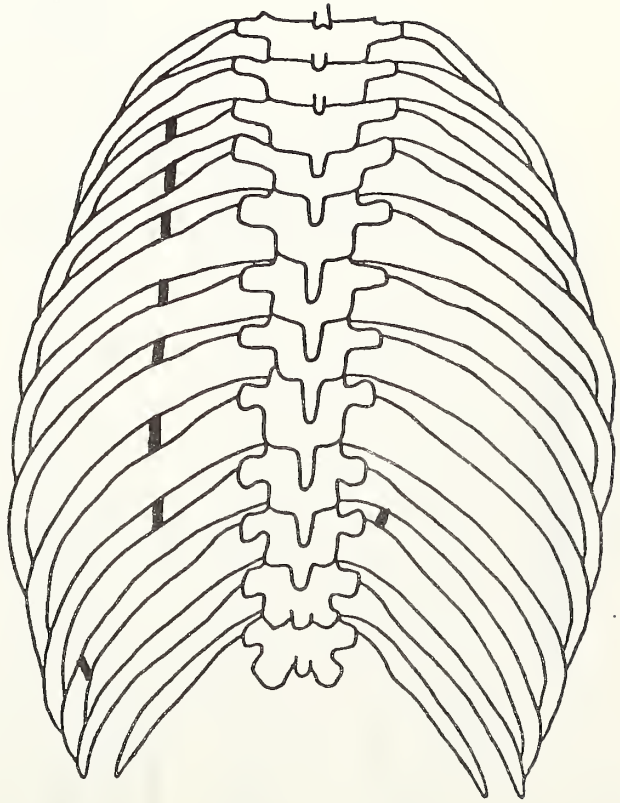
Run No. H 82 o8 DOT





Number of rib fractures 18

Run No. 8221

a) Subject:
Male, 48 years, body weight 99 kg, body length 180 cm, (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, APR padding, impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 3rd to 11th rib left paravertebral. Laceration of the pleura in the fracture area of the 6th, 8th, 9th and 10th rib. Fracture of the 3rd, 4th and 5th rib left in the cartilage area and in the cartilage-bone transition. Fracture of the 6th rib left in the front axillar line. Fracture of the 7th and 8th rib left in the cartilage area. Fracture of the 9th, 10th and 11th rib left in the medium axillar line. Fracture of the 3rd rib right in the front axillar line; fracture of the 8th, 9th and 10th rib right in the rear axillar line.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral column:	Hemorrhages in the vertebral discs C2/C3, C3/C4, C4/C5, C5/C6 and C6/C7 dorsal.
e) AIS-Severity:	Body surface 0, head 0, thorax 4, abdomen 0, pelvis 0, vertebral column 1, MAIS 4.

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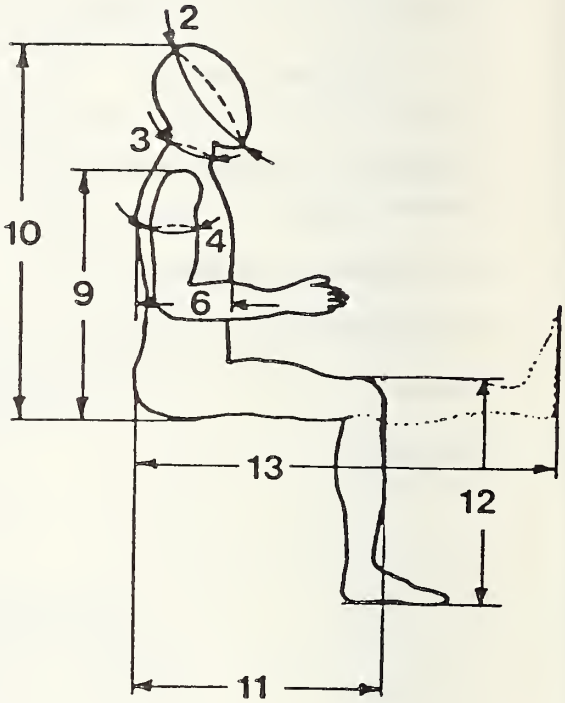
Run No. H 82 21 DOT

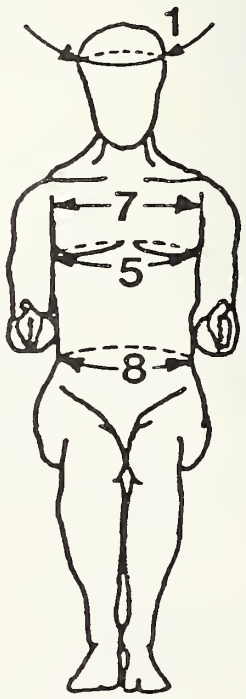
Anthropometrical Data

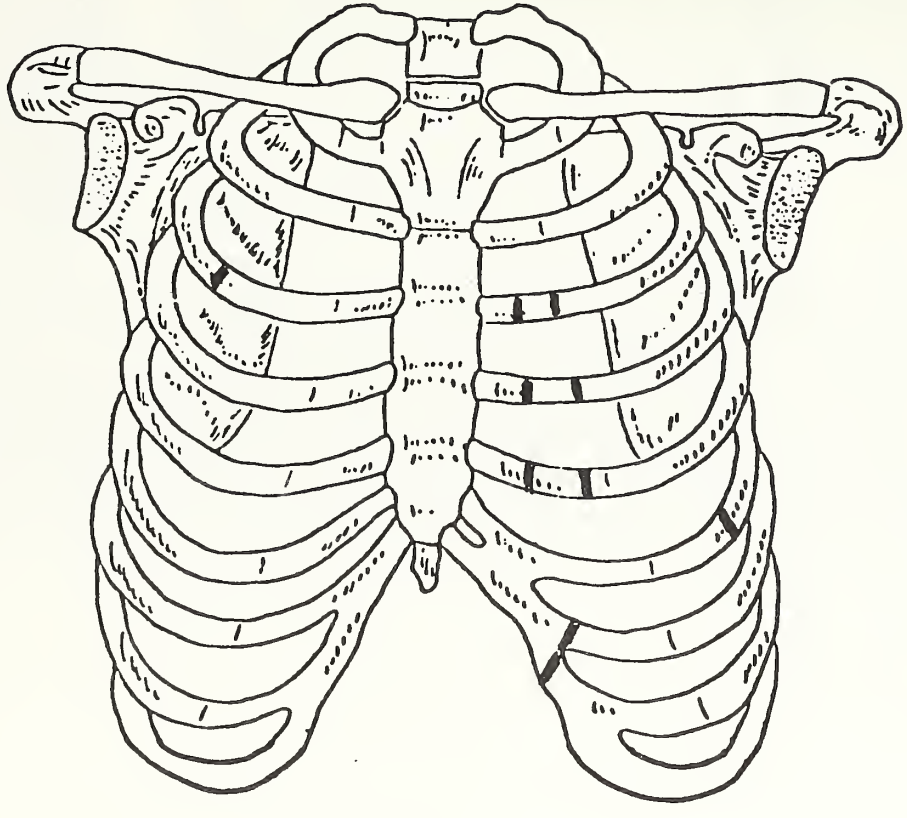
Body weight ..... 99 kg

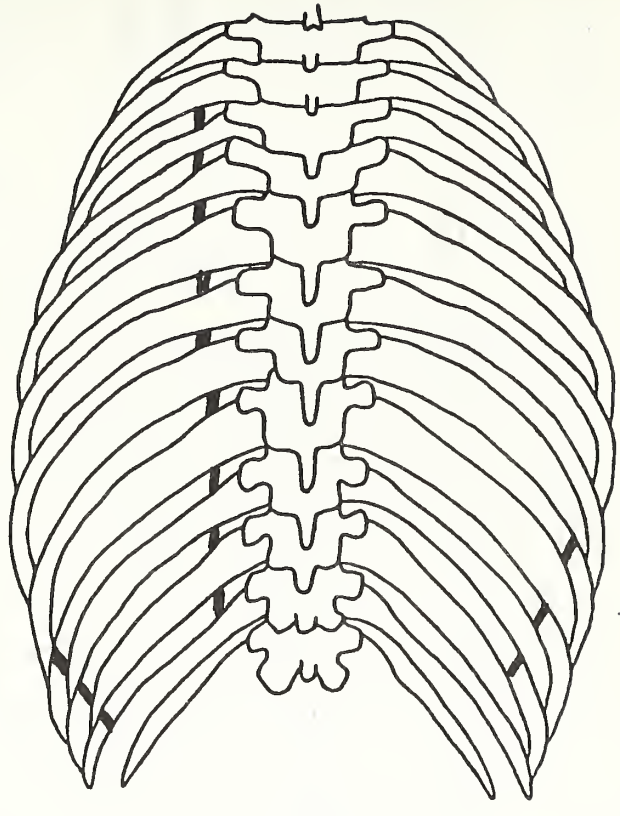
Body length ..... 18o cm

1. Hat dimension ..... 55 ..... cm
2. Head circumference ..... 63 ..... cm
3. Neck circumfer. ..... 44 ..... cm
4. Upper arm circumfer. ..... 31 ..... cm
5. Chest circumfer. ..... 1o6 ..... cm
6. Chest height ..... 26 ..... cm
7. Chest width ..... 36 ..... cm
8. Abdomen circumfer. ..... 1o2 ..... cm
9. Buttocks - shoulder ..... 73 ..... cm
10. Seat height ..... 94 ..... cm
11. Pelvis - knee ..... 61 ..... cm
12. Sole of foot - knee ..... 56 ..... cm
13. Pelvis - heal ..... 1o6 ..... cm









Number of rib fractures 25 .....

Run No. H8222

a) Subject:
Male, 50 years, body weight 77 kg, body length 167 cm, (further anthropometric data, s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, APR-padding, impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder force, pelvis force.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 3rd and 4th rib left in the medium axillar line; fracture of the 5th to 7th rib in the front axillar line. Fracture of the 1st, 2nd, 8th and 9th rib left in the rear axillar line. Fracture of the 1st to 10th rib in the paravertebral region. Fracture of the 8th rib left in the medium scapula line. Fracture of the 4th and 5th rib right in the front axillar line, of the 2nd and the 3rd rib in the rear axillar line; fracture of the 1st rib right in the paravertebral region.
Abdomen:	Rupture of the spleen (8 cm long, 5 mm deep), laceration of the spleen tissue in the near of the hilus (3 cm long, 5 mm deep).
Pelvis:	No injuries.

Vertebral column: Hemorrhages in the vertebral discs C3/C4, C4/C5, C5/C6 dorsal. Rupture of the vertebral disc C5/C6.

Extremities: No injuries.

e) AIS-Severity: Body surface 0, head 0, thorax 4, abdomen 5, pelvis 0, vertebral column 2, extremities 0, MAIS 5.

BENDING TESTS

Run No.	Rib	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
H 8222	6th	138	3,15	28,6
	7th	158	3,4	27,9

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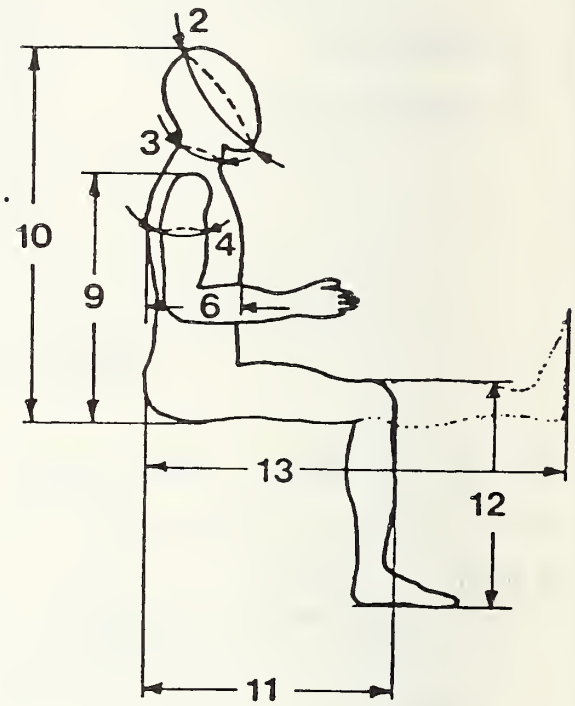
Run No. H 82 22 DOT

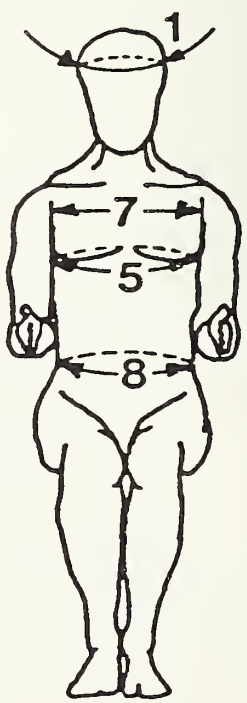
Anthropometrical Data

Body weight ....77.... kg

Body length ....167.... cm

1. Hat dimension .....55.....cm
2. Head circumference.....64.....cm
3. Neck circumfer. .....38.....cm
4. Upper arm circumfer. .....28.....cm
5. Chest circumfer. .....95.....cm
6. Chest height .....22.....cm
7. Chest width .....33.....cm
8. Abdomen circumfer. .....85.....cm
9. Buttocks - shoulder .....72.....cm
10. Seat height .....93.....cm
11. Pelvis - knee .....55.....cm
12. Sole of foot - knee .....52.....cm
13. Pelvis - heal .....86.....cm





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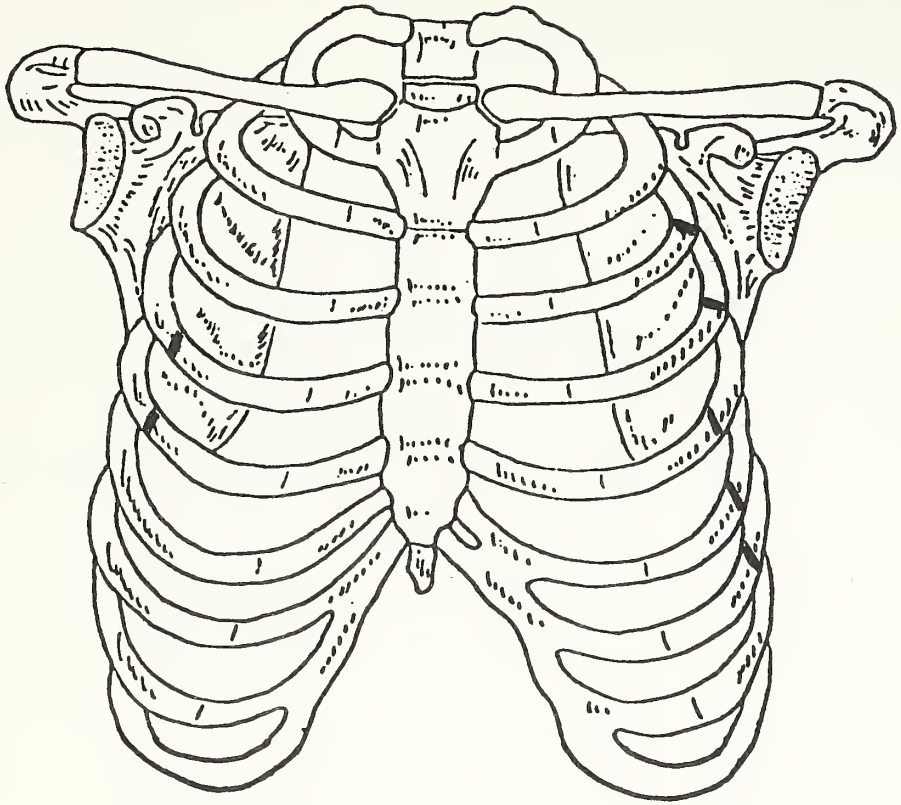
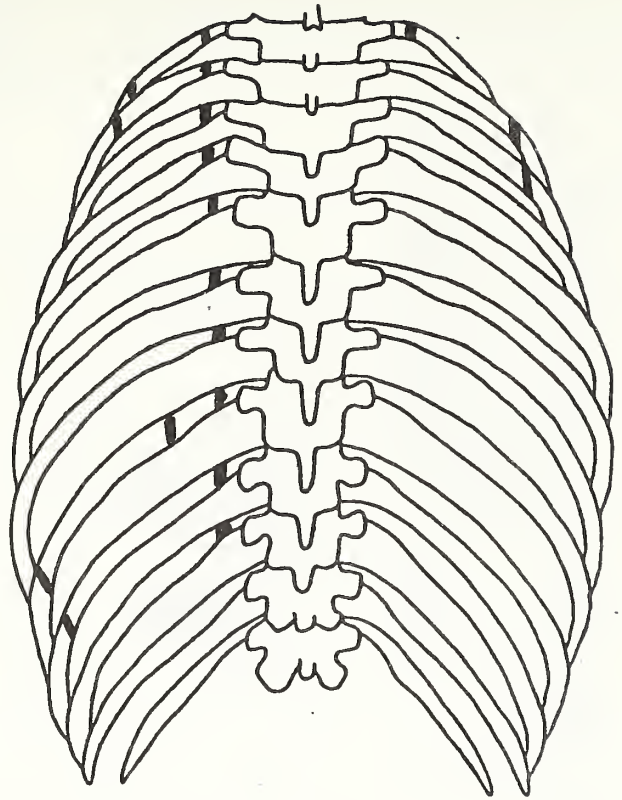
H 32 22 DOT
Run No. .....





Number of rib fractures ..25..

APPENDIX VI

LATERAL IMPACT CADAVER TESTS INTO A WALL WITH 2,6,12'' ENS.PAD. IMPACT VELOCITY : 32 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin c cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8310	female	30	56	176	54	57	32	24	80
H 8311	male	26	61	188	56	62	31	22	87
H 8312	male	34	77	178	54	63	36	28	92
H 8320	female	17	52	153	51	59	32	24	72
H 8408	male	79	64	168	57	65	42	30	98
5	M 3 F 2	37.2	62	172.6	54.4	61.2	34.6	25.6	85.8

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8310	17	27	78	70	93	59	52	103
H 8311	21	31	75	71	96	65	58	111
H 8312	22	32	89	76	95	58	53	102
H 8320	18	25	62	62	83	54	45	88
H 8408	26	34	99	69	90	57	51	97
5	20.8	29.8	80.6	69.6	91.4	58.6	51.8	100.2

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8310	6'' Ens	27	0	0	0	0	0	0	0
H 8311	12''Ens	31	0	0	0	0	0	0	0
H 8312	6'' Ens	32	0	0	0	0	0	0	0
H 8320	6'' Ens	31	0	0	0	0	0	0	0
H 8408	2'' Ens	32	19	19	8	11	0	0	0
5	2'' Ens	30.6	3.8	3.8	1.6	2.2	0	0	0

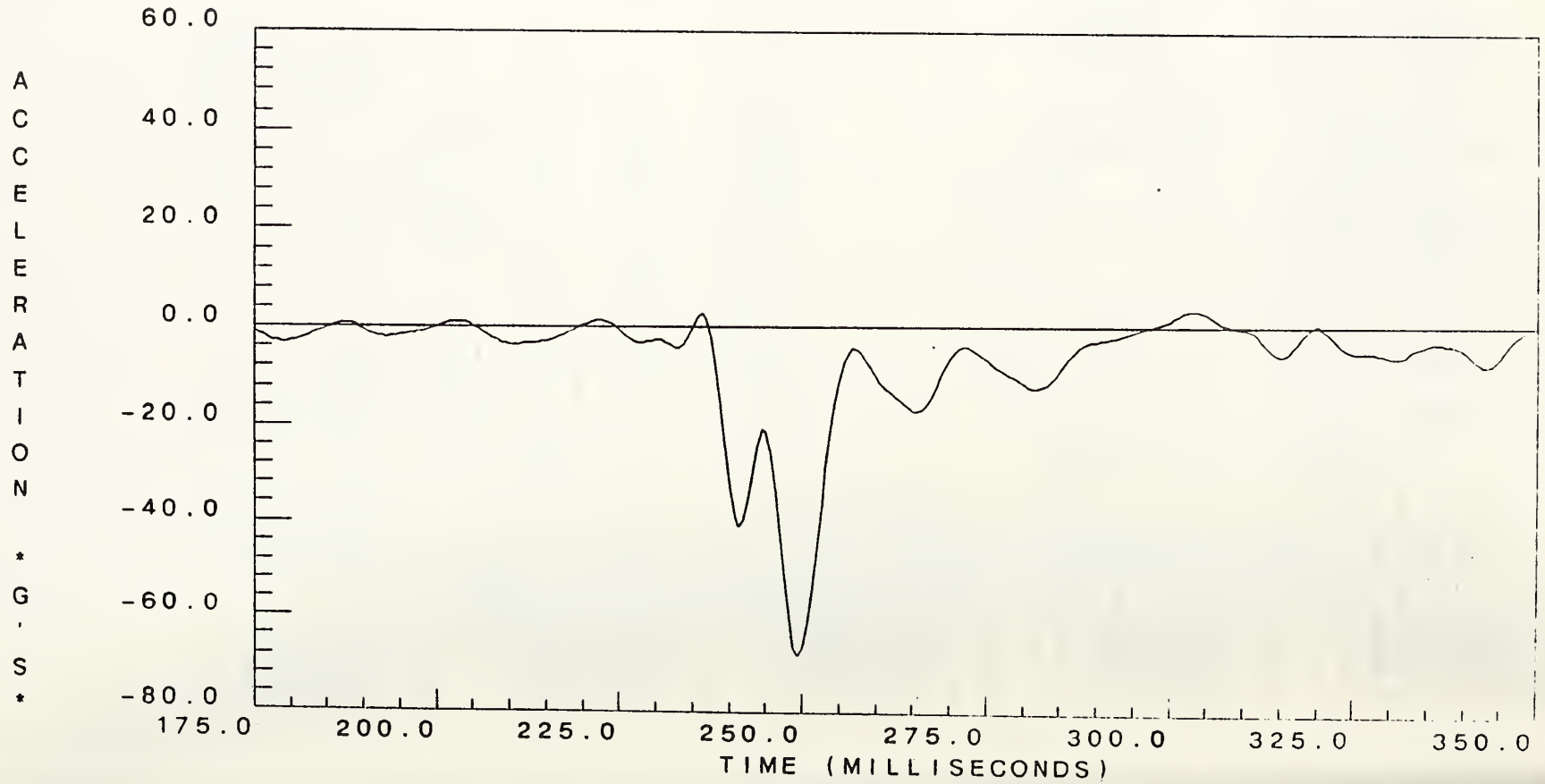
AIS - SEVERITY

Run No	Body Sur-face	Head	Thorax	Abdomen	Pelvis	Spine	Extrem.	MAIS
H 8310	0	0	0	0	0	2	0	2
H 8311	0	0	0	0	0	0	0	0
H 8312	0	0	0	0	0	1	0	1
H 8320	0	0	0	0	0	0	0	0
H 8408	0	0	4	0	0	2	0	4
5	0	0	.8	0	0	1	0	1

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
H 8310	296	2.45	34.7	280	2.25	45.0
H 8311	163.6	2.2	20.1	107.2	3.0	21.1
H 8312	215	5.8	39	228	4.0	29
H 8320	240	7.4	35	172	8.2	28
H 8408	346	3.6	48	200	5.0	37
5	252.1	4.29	35.36	197.4	4.49	32.22

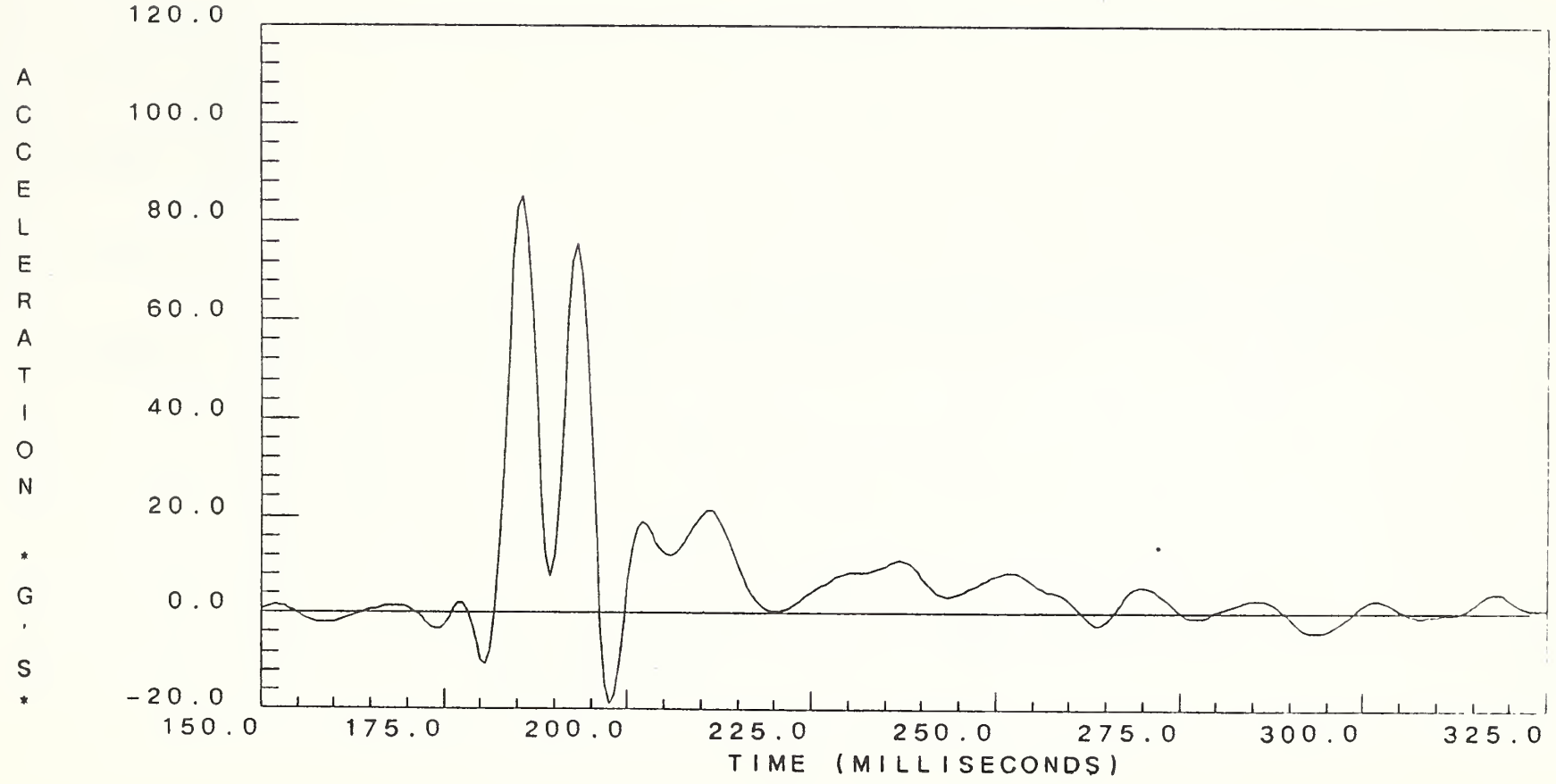
Side Impact

15 MPH Ensolite(6"), Upper Rib (Y)



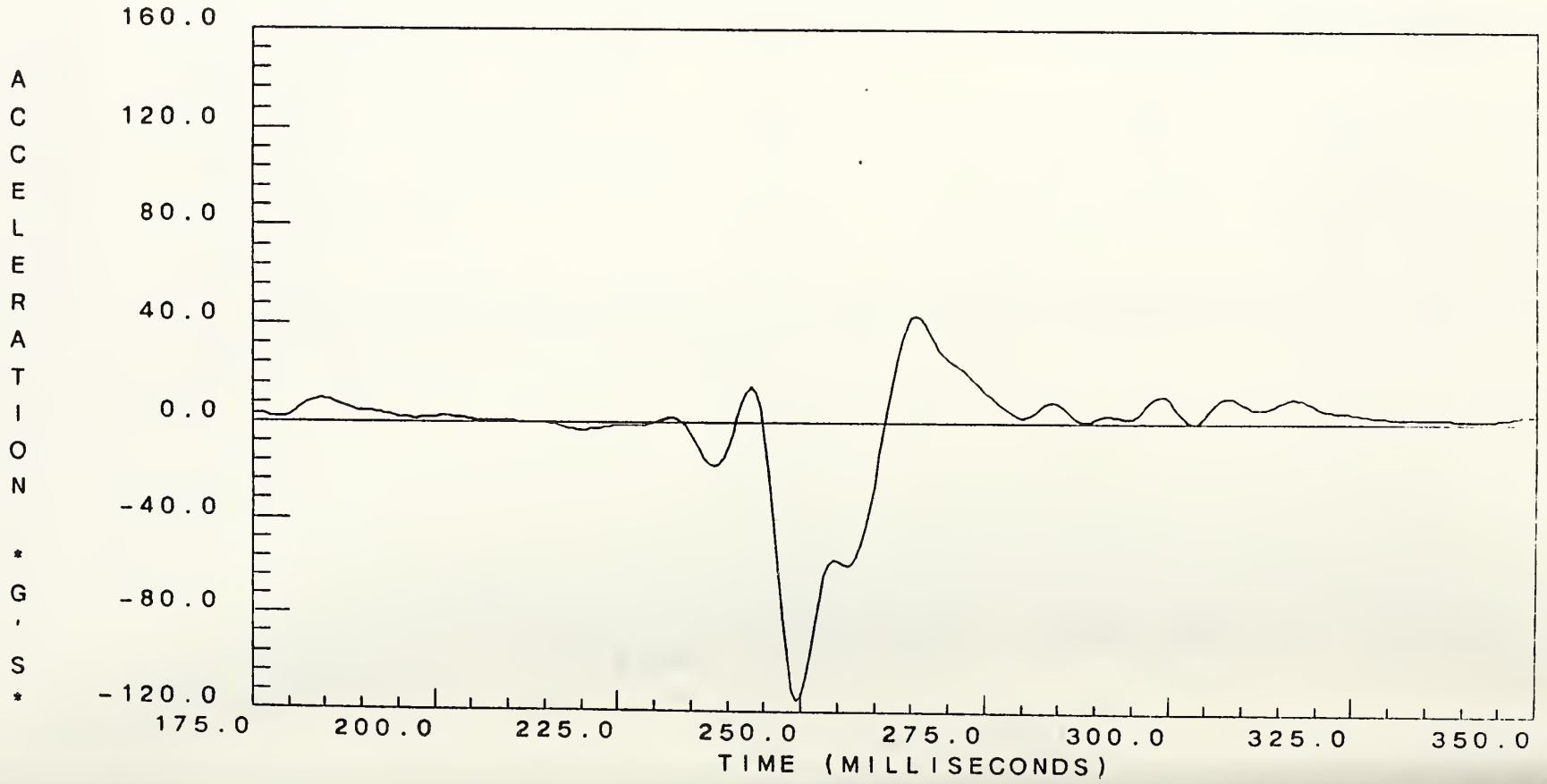
Side Impact

15 MPH Ensolite(6"), Lower Rib (Y)



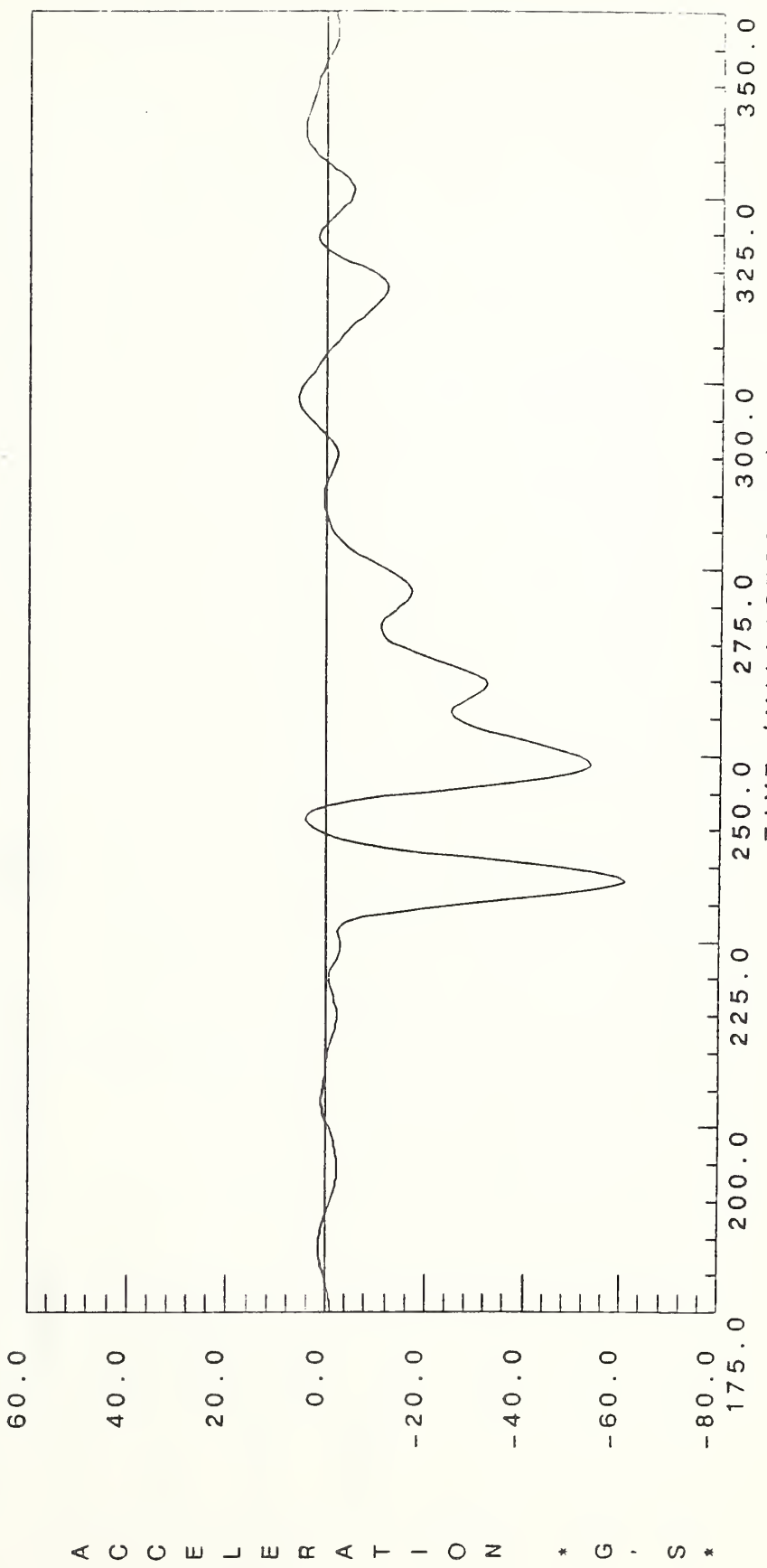
Side Impact

20 MPH Ensolite(1"), Upper Rib (Y)



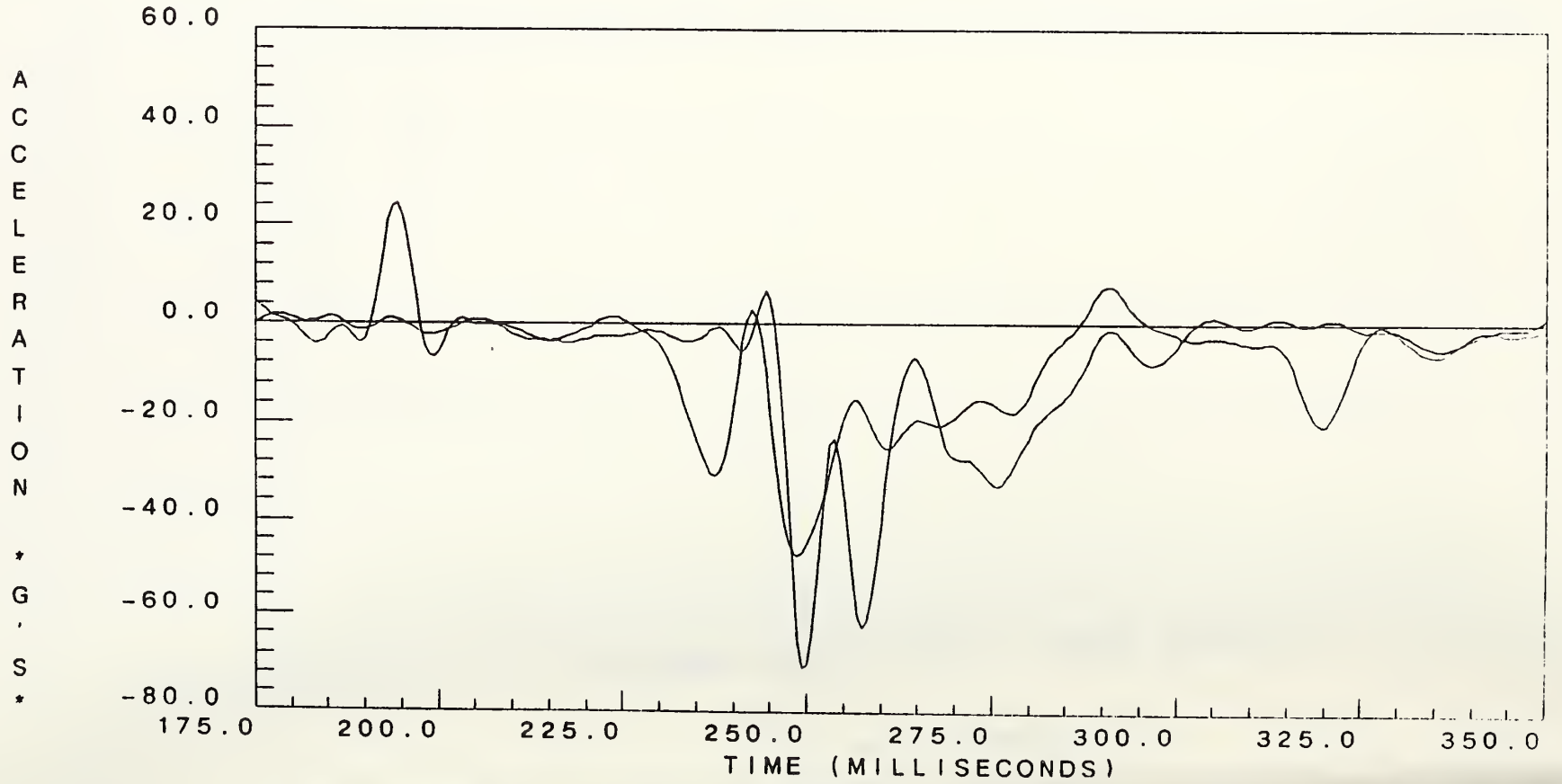
Side Impact

20 MPH Ensolite(6"), Upper Rib (Y)



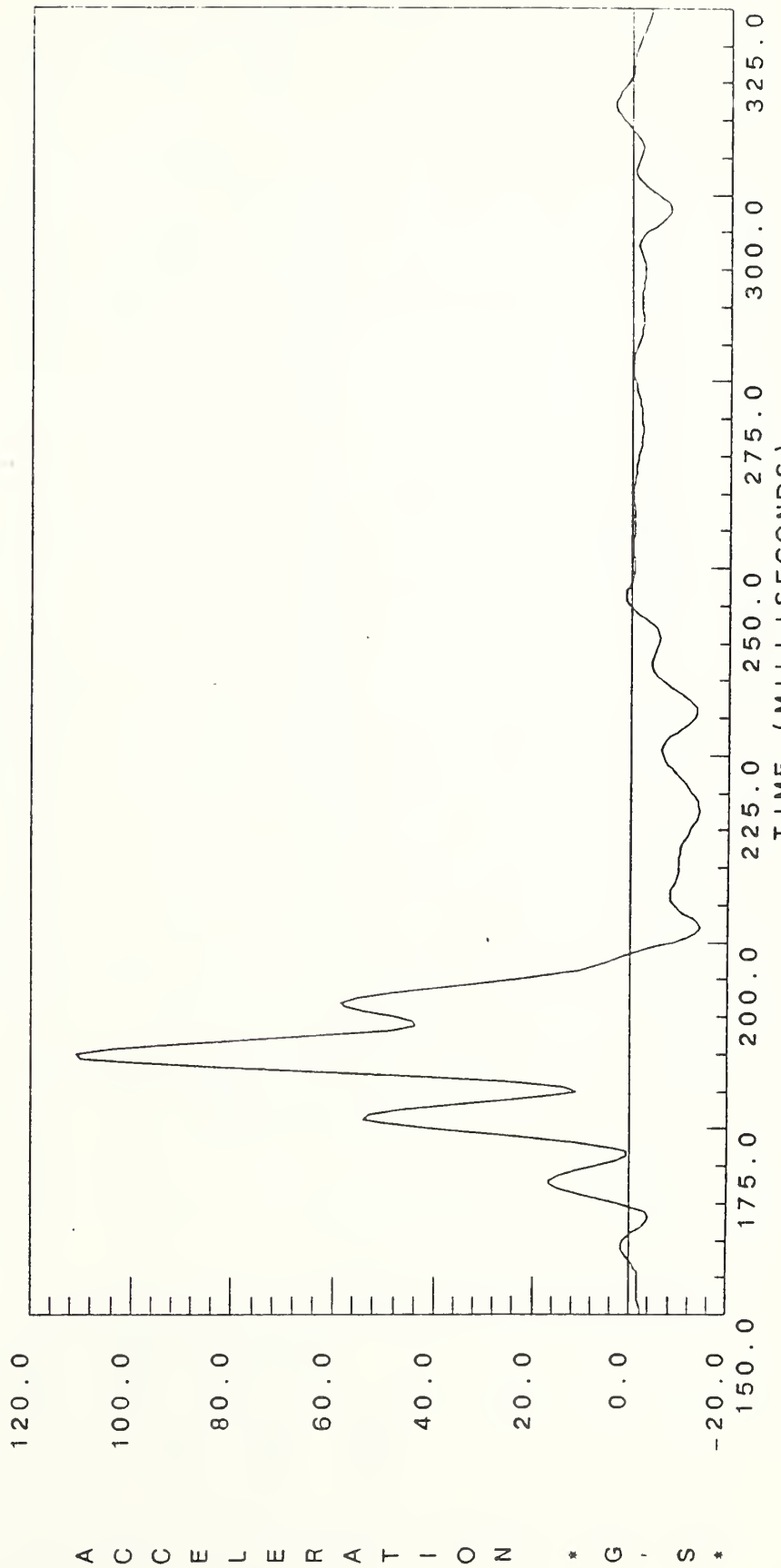
Side Impact

20 MPH Ensolite(12"), Upper Rib (Y)



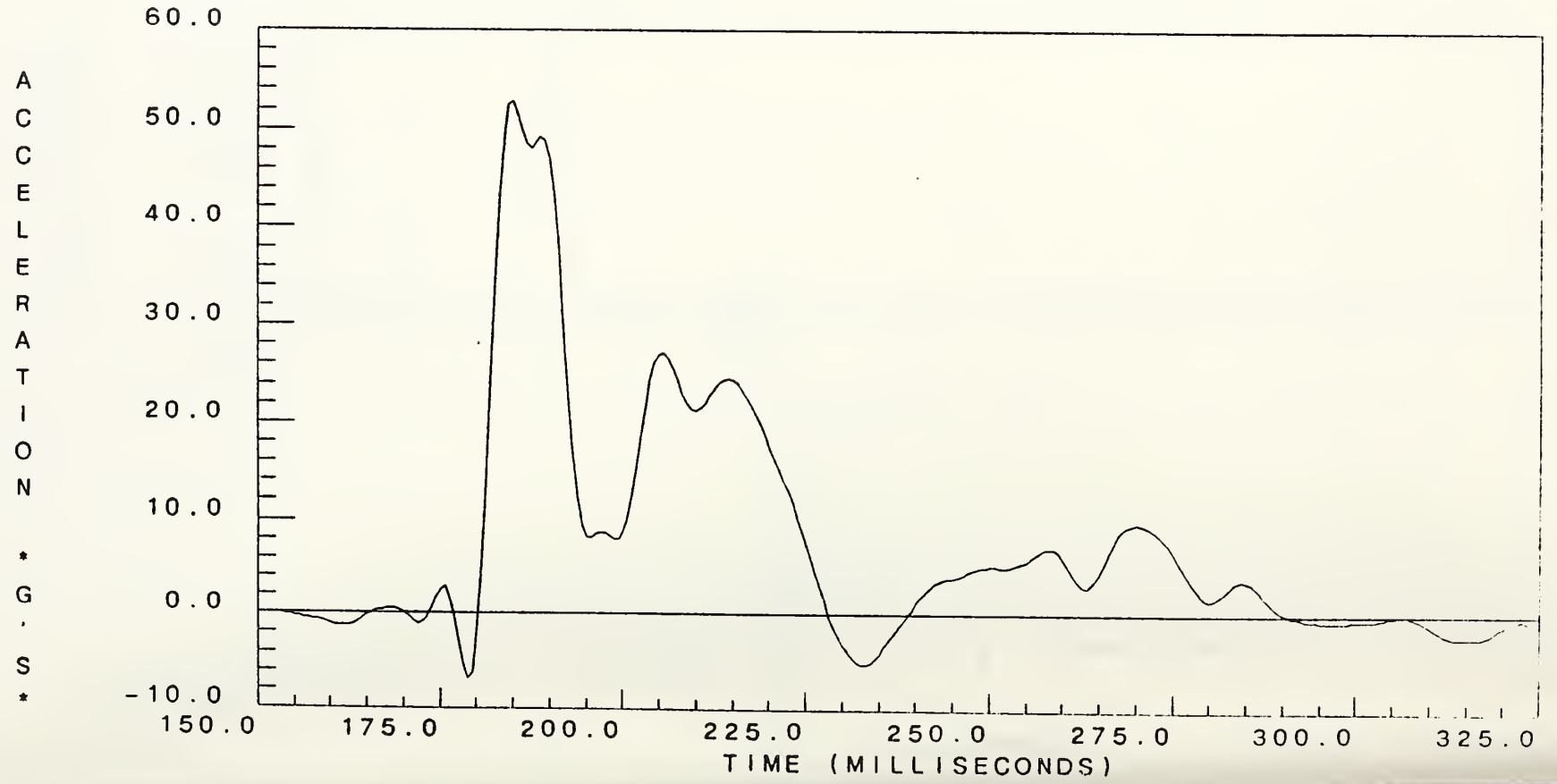
Side Impact

20 MPH Ensolite(1"), Lower Rib (Y)



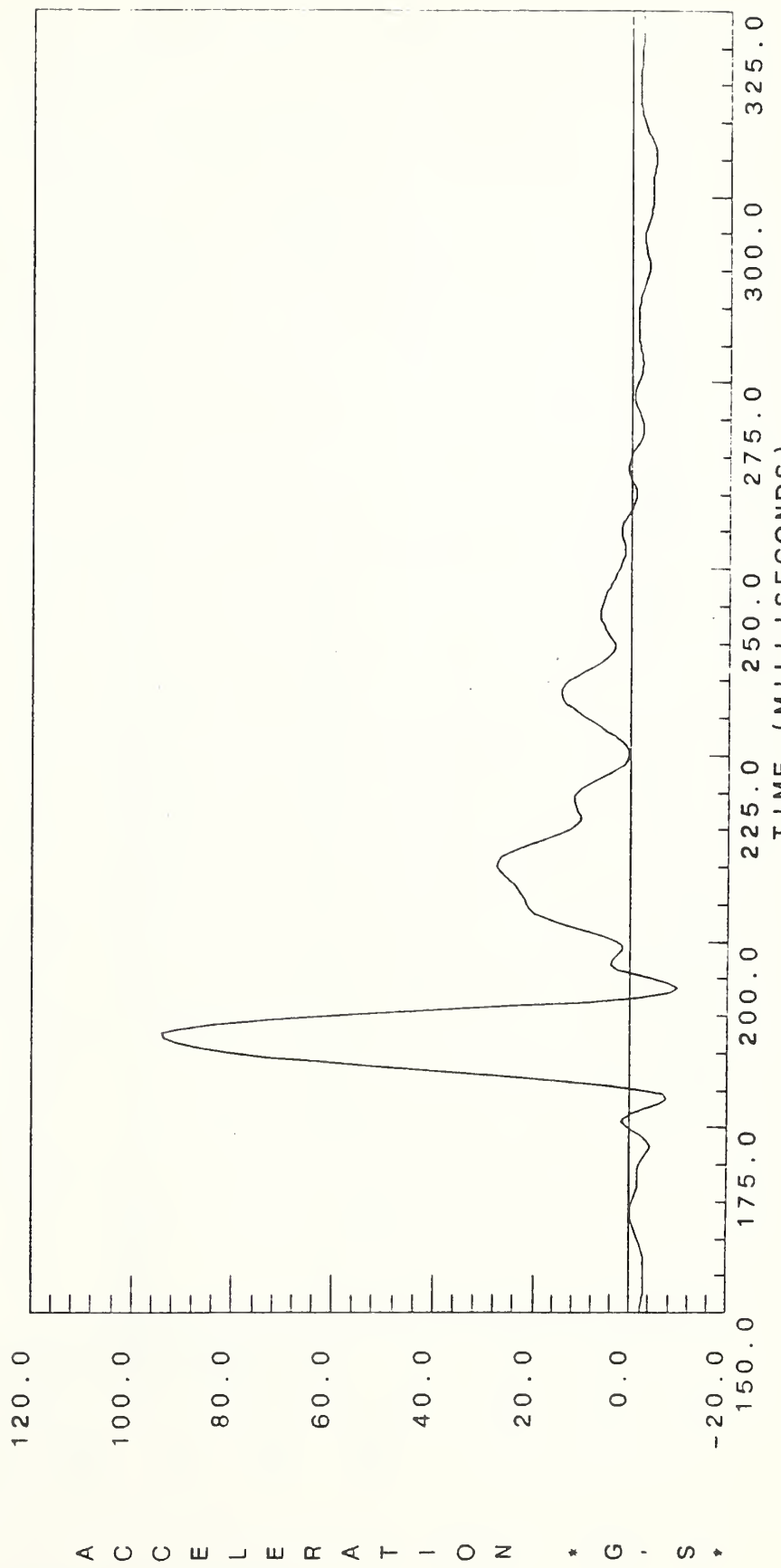
Side Impact

20 MPH Ensolite(6"), Lower Rib (Y)



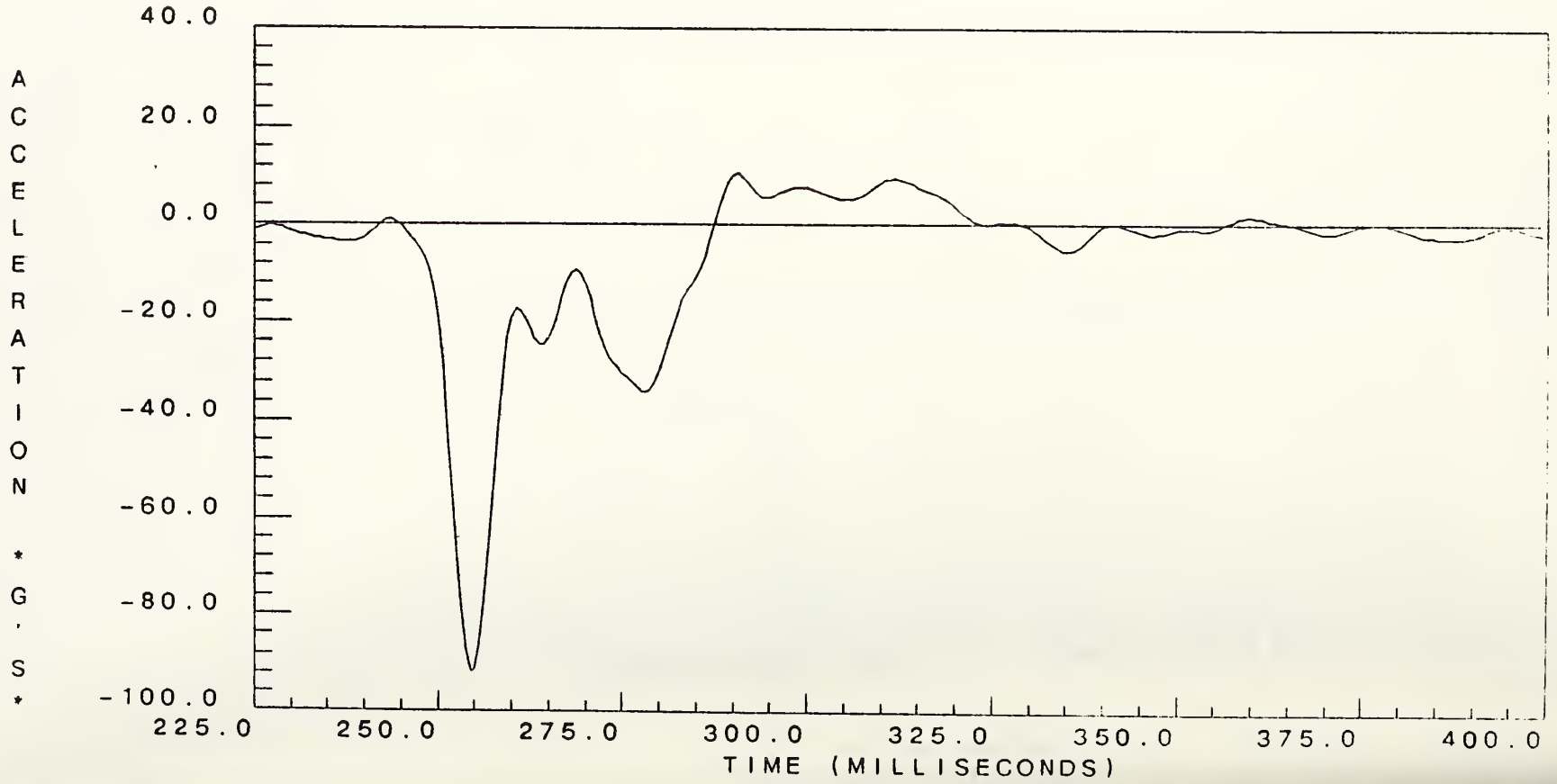
Side Impact

20 MPH Ensolite(12"), Lower Rib (Y)



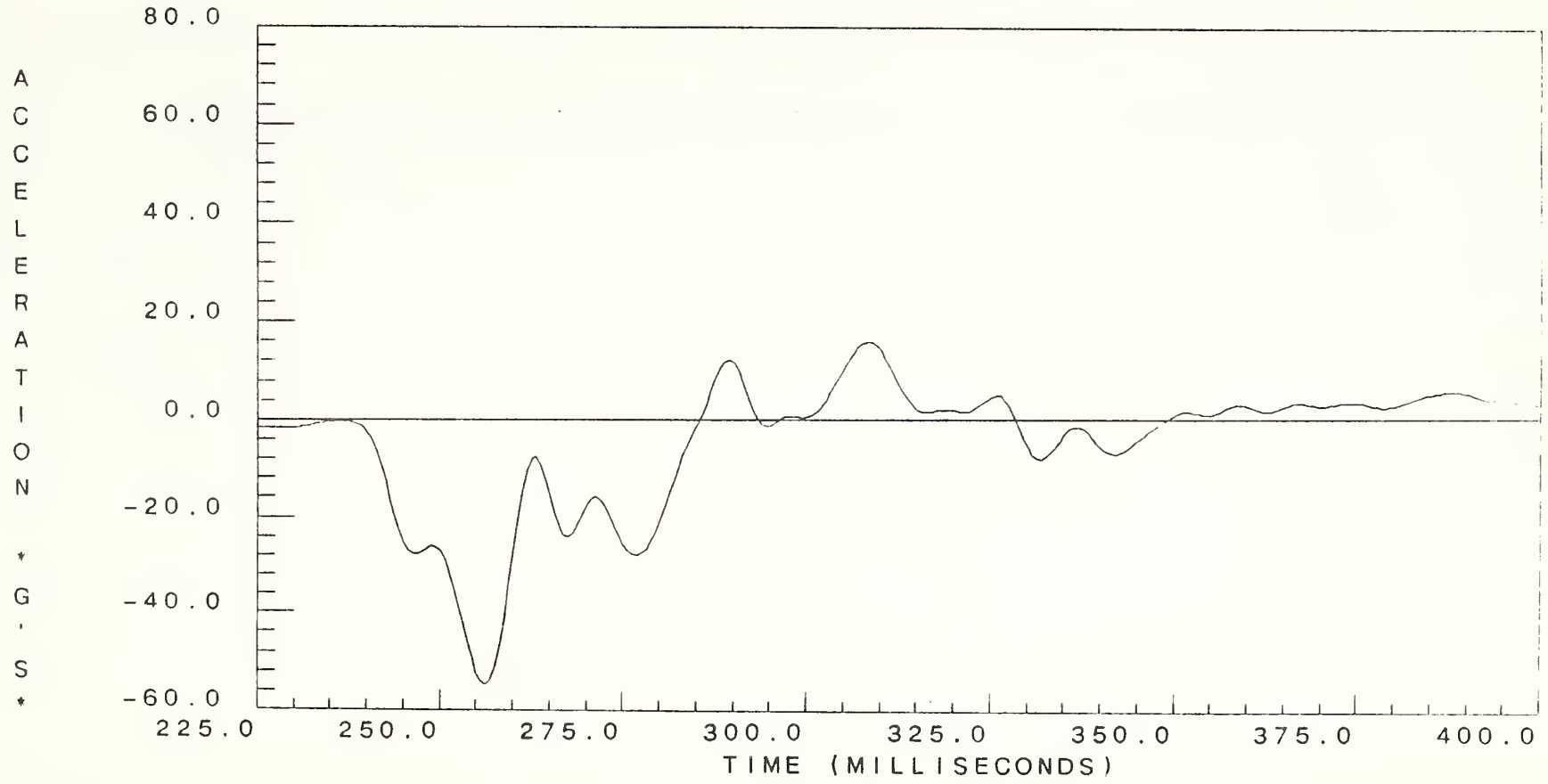
Side Impact

20 MPH Ensolite(12"), Upper Spine (Y)



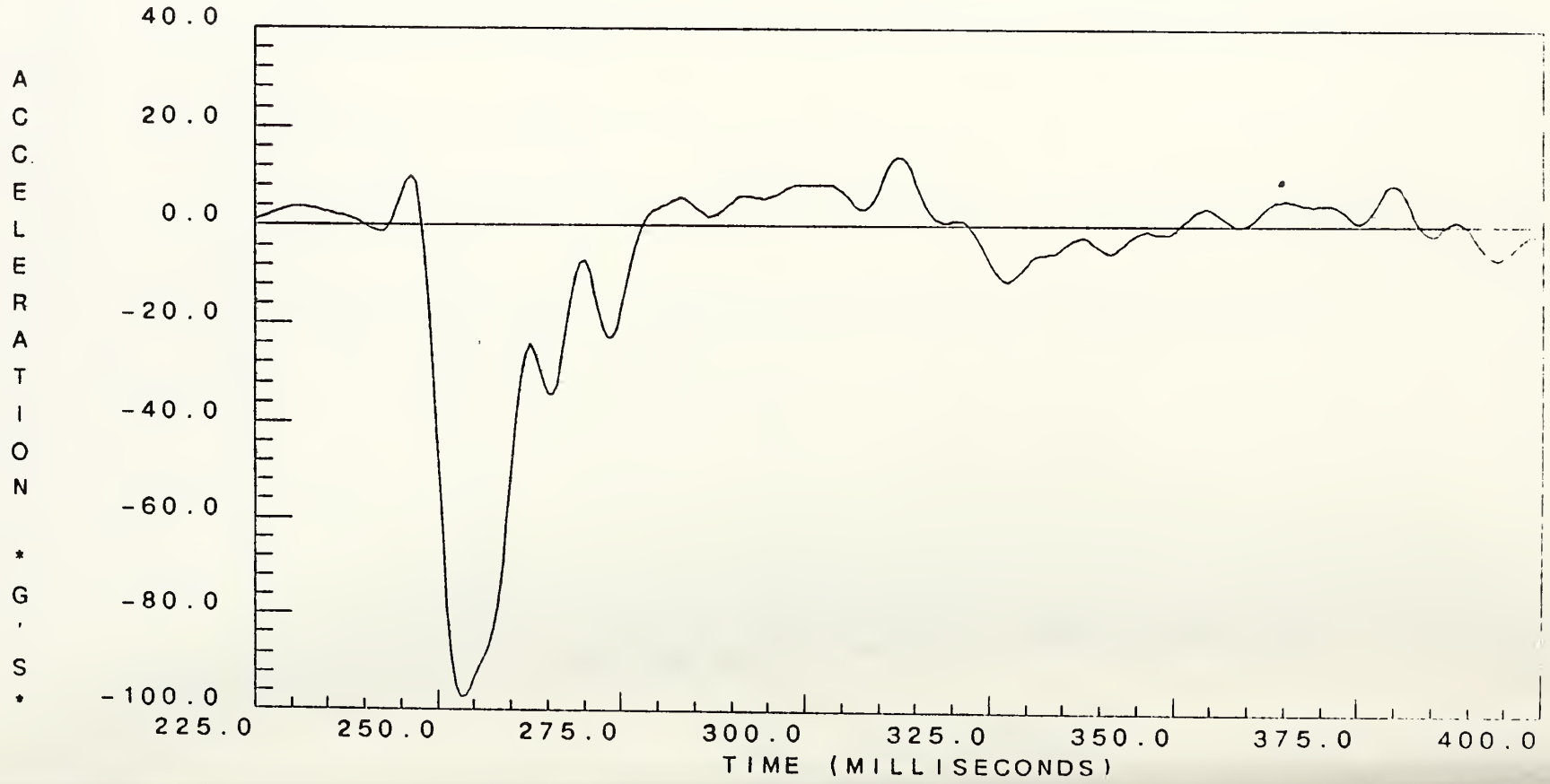
Side Impact

20 MPH Ensolite(6"), Upper Spine (Y)



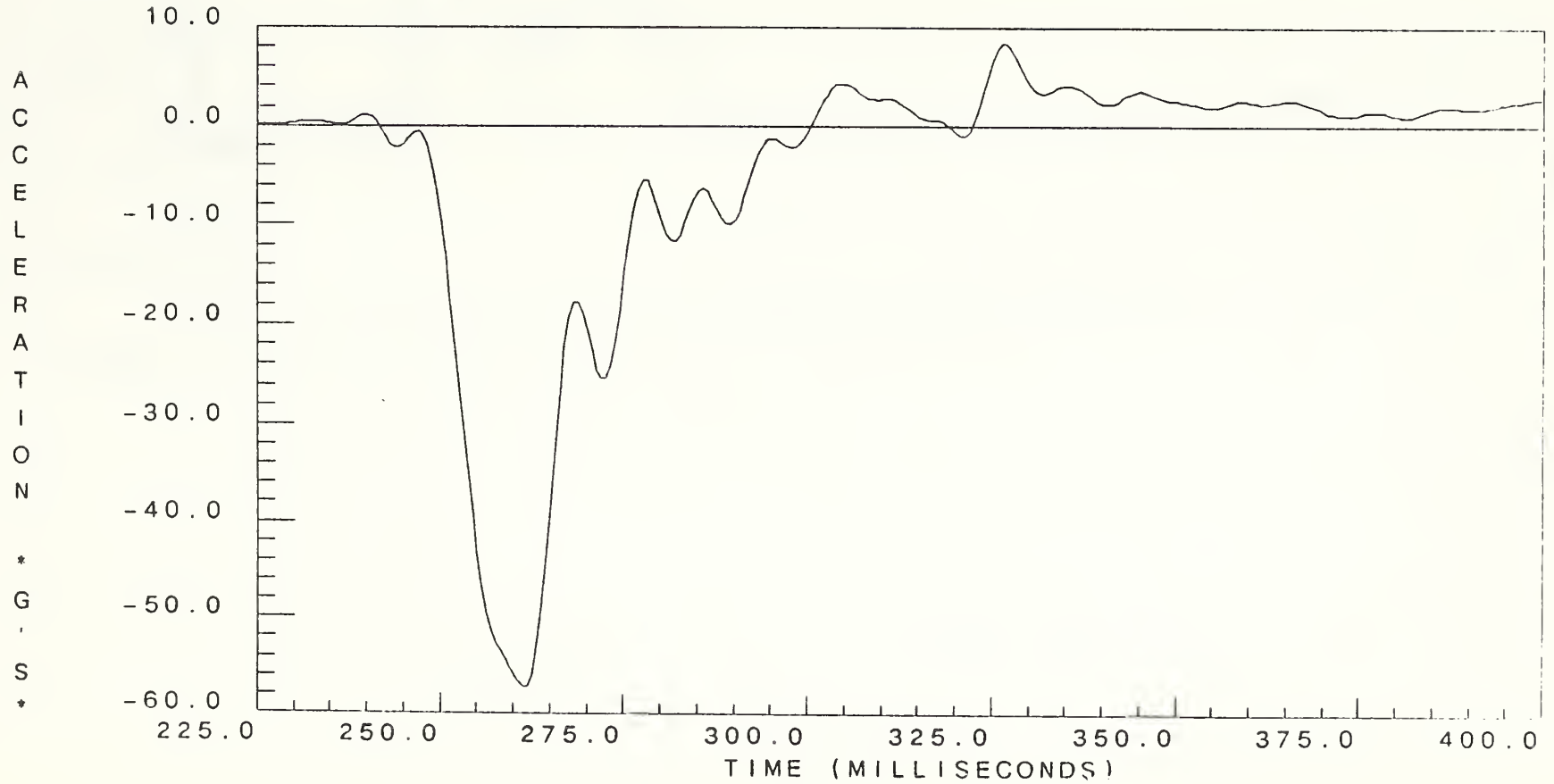
Side Impact

20 MPH Ensolite(1"), Upper Spine (Y)



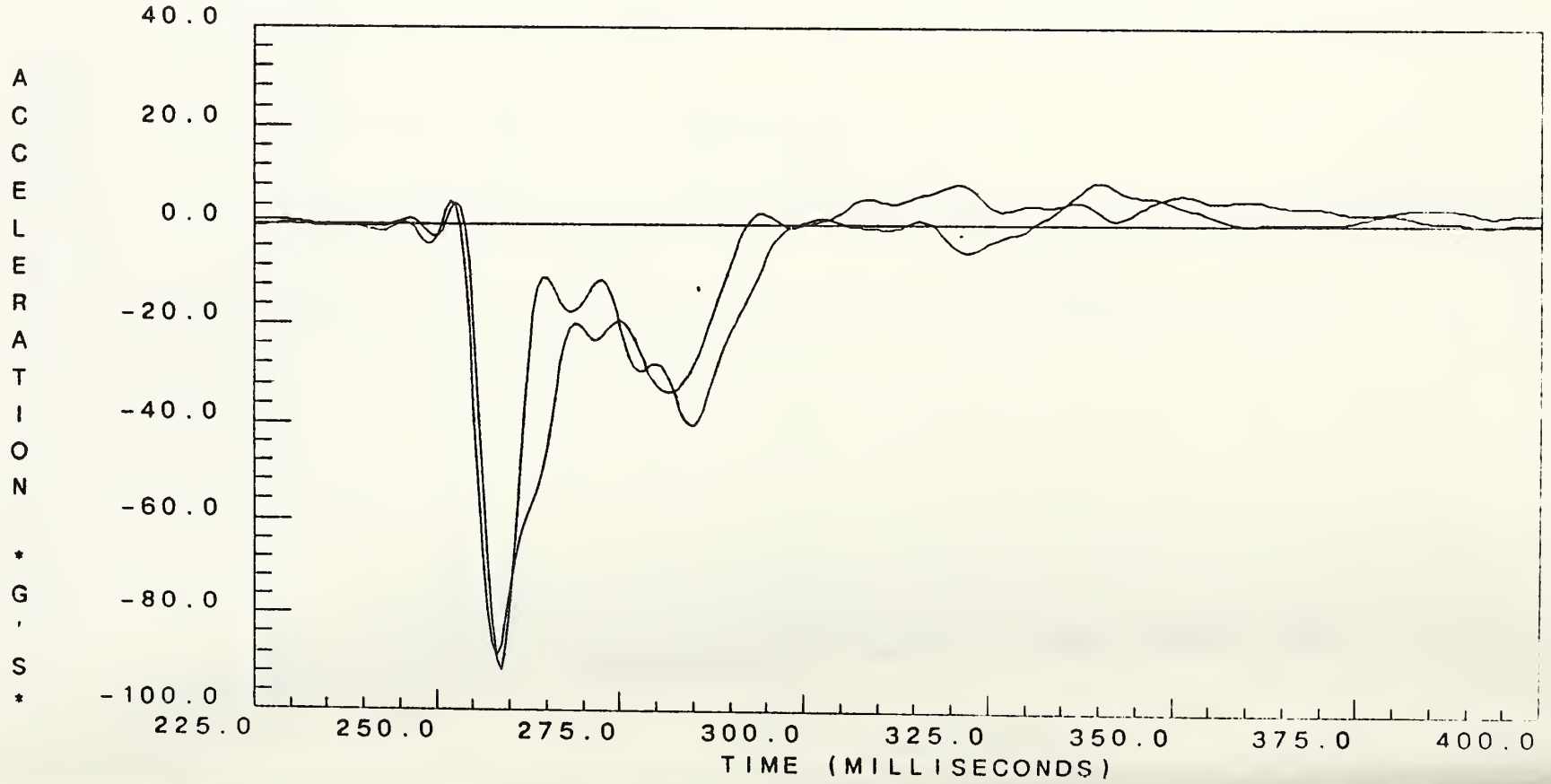
Side Impact

15 MPH Ensolite(6"), Lower Spine (Y)



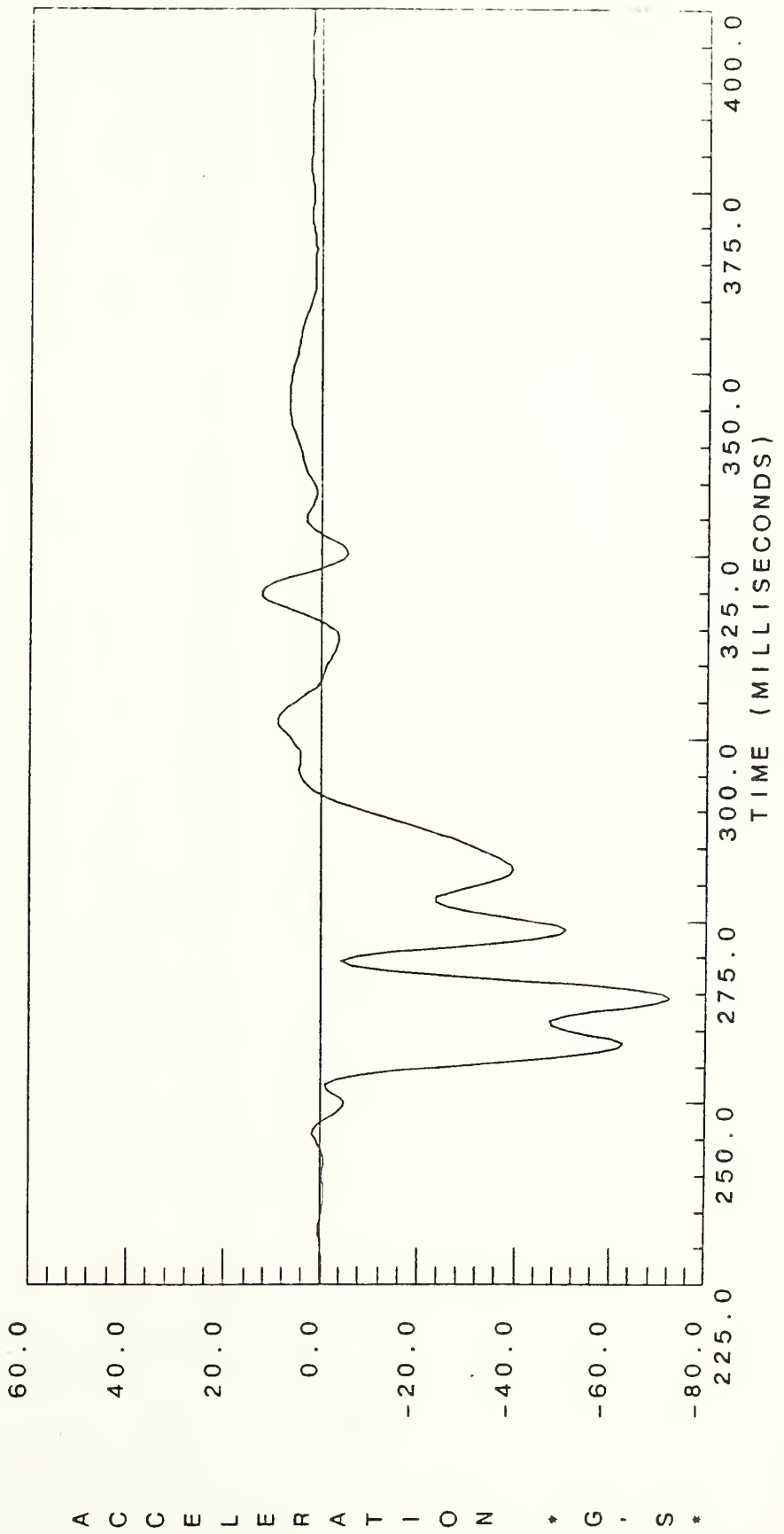
Side Impact

20 MPH Ensolite(12"), Lower Spine (Y)



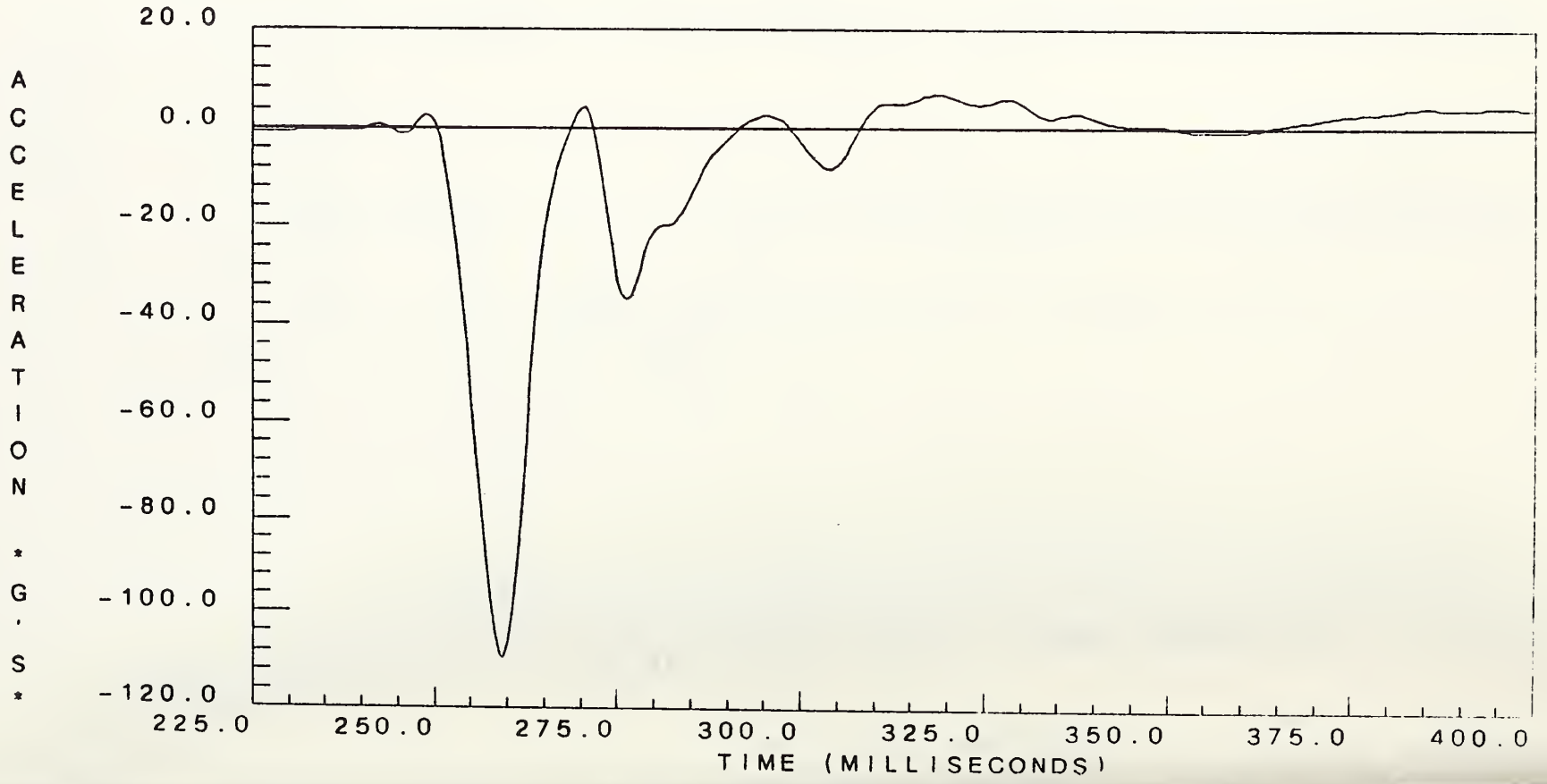
Side Impact

20 MPH Ensolite(6"), Lower Spine (Y)



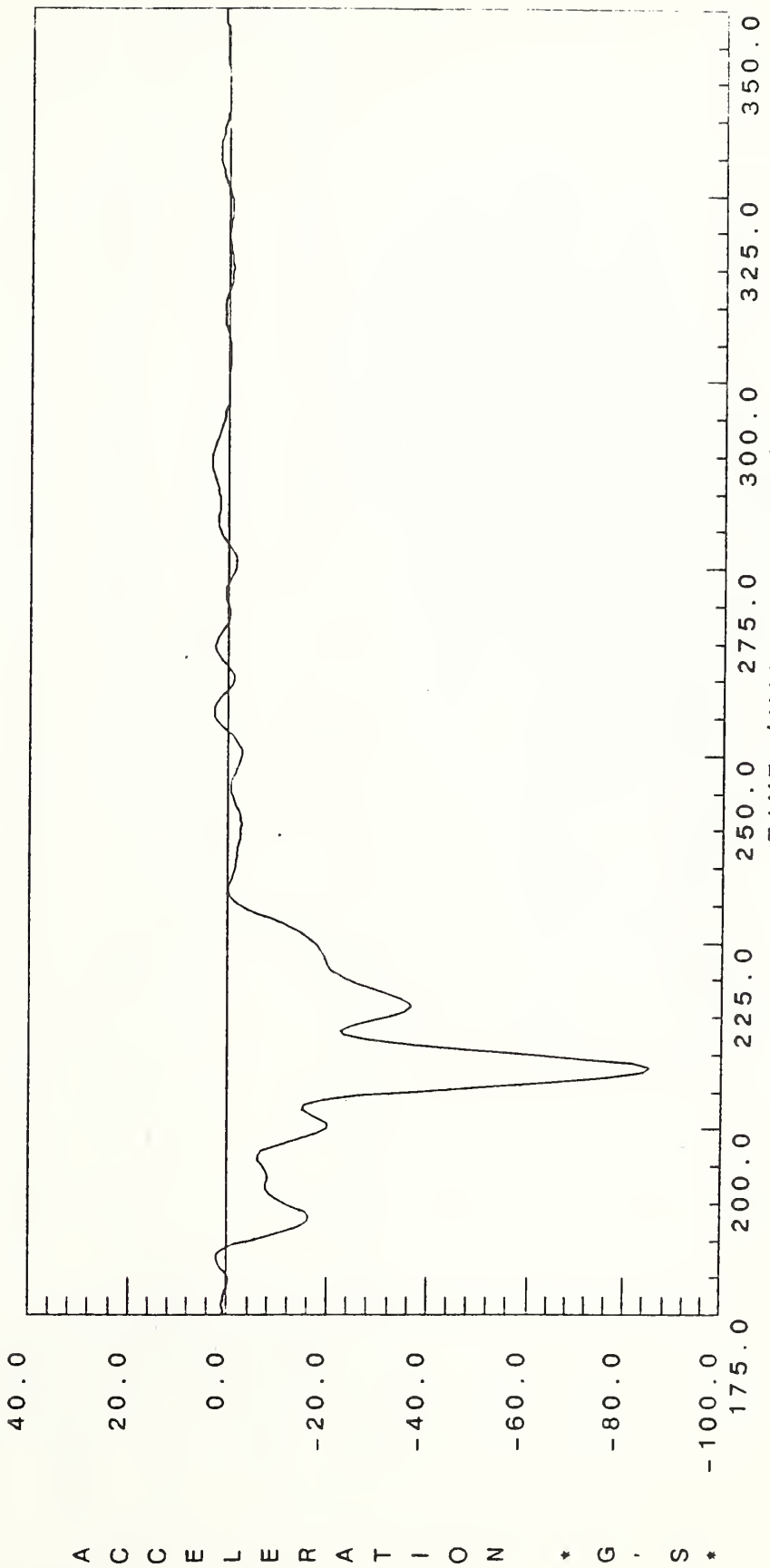
Side Impact

20 MPH Ensolite(1"), Lower Spine (Y)



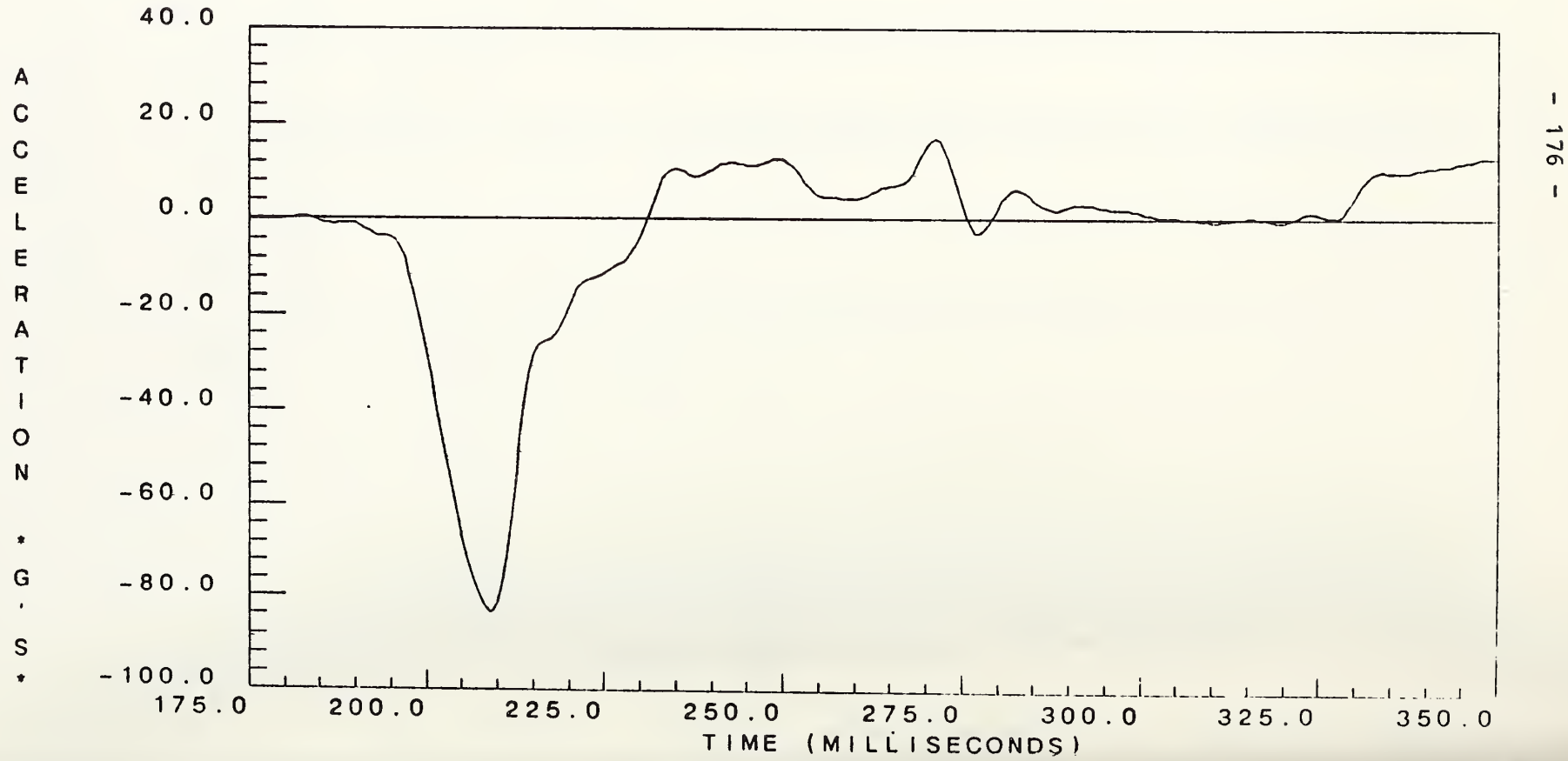
Side Impact

15 MPH Ensolite(6"), Pelvis (Y)



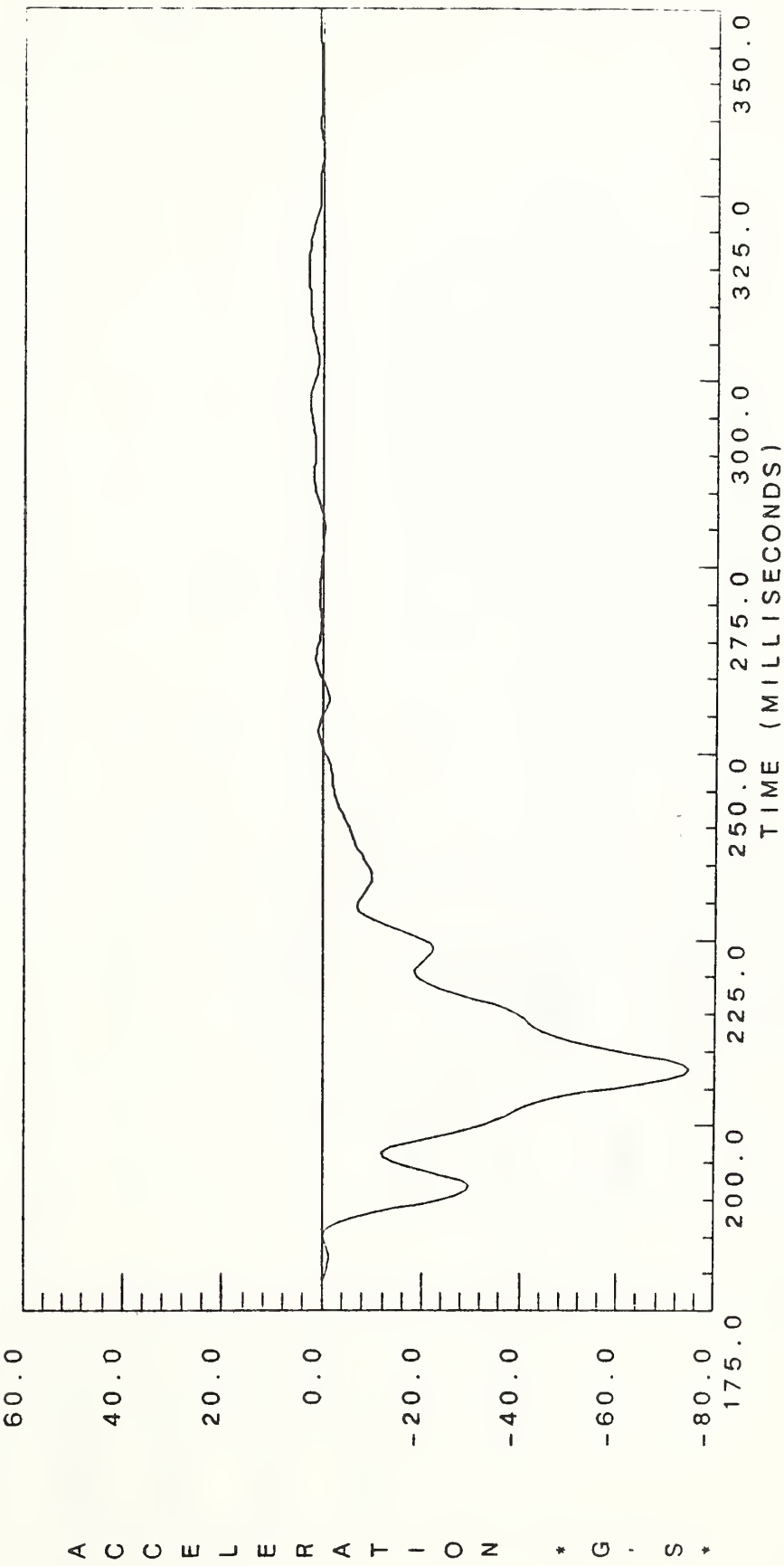
Side Impact

20 MPH Ensolite(1"), Pelvis (Y)



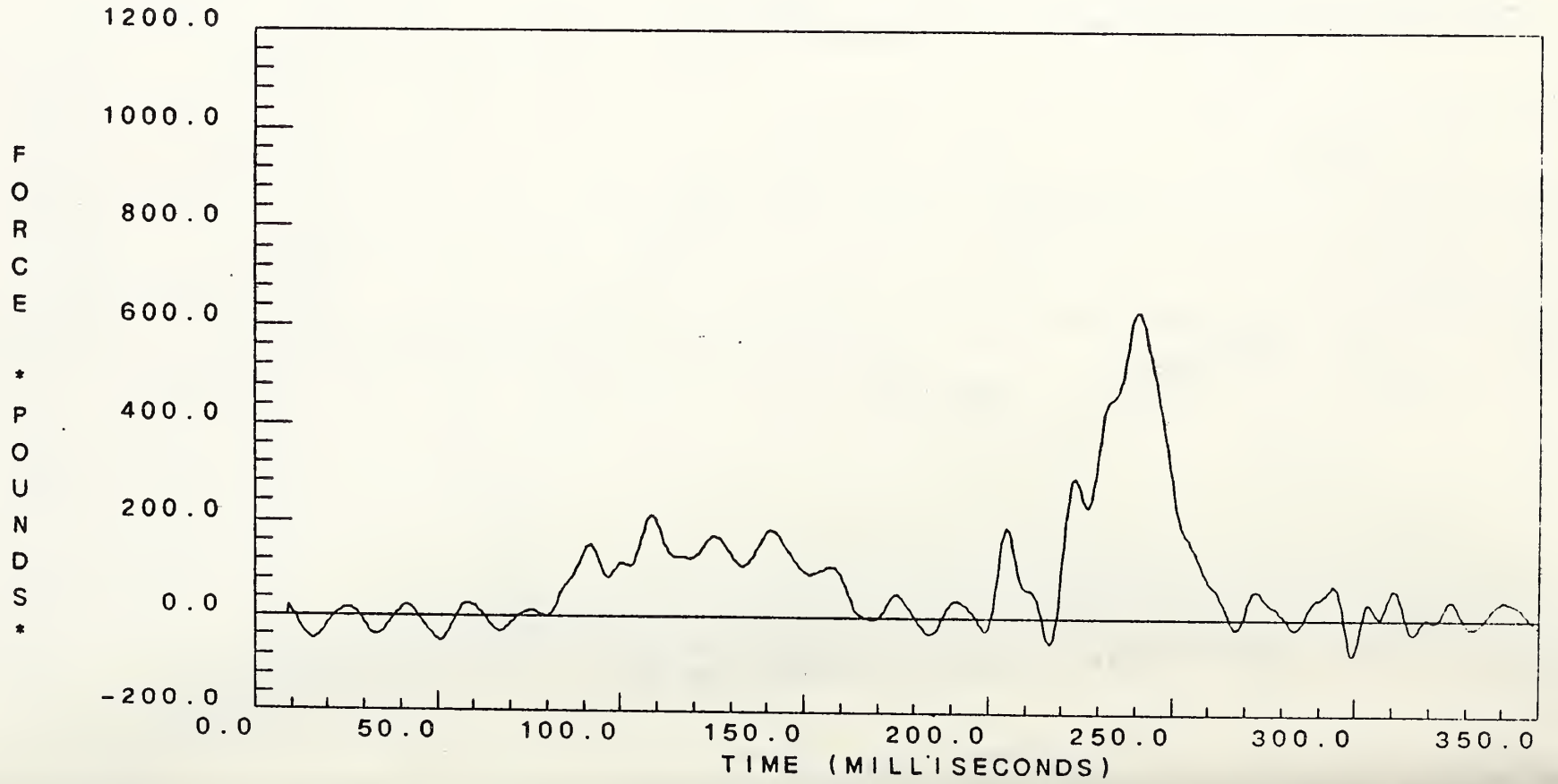
Side Impact

20 MPH Ensolite(12"), Pelvis (Y)



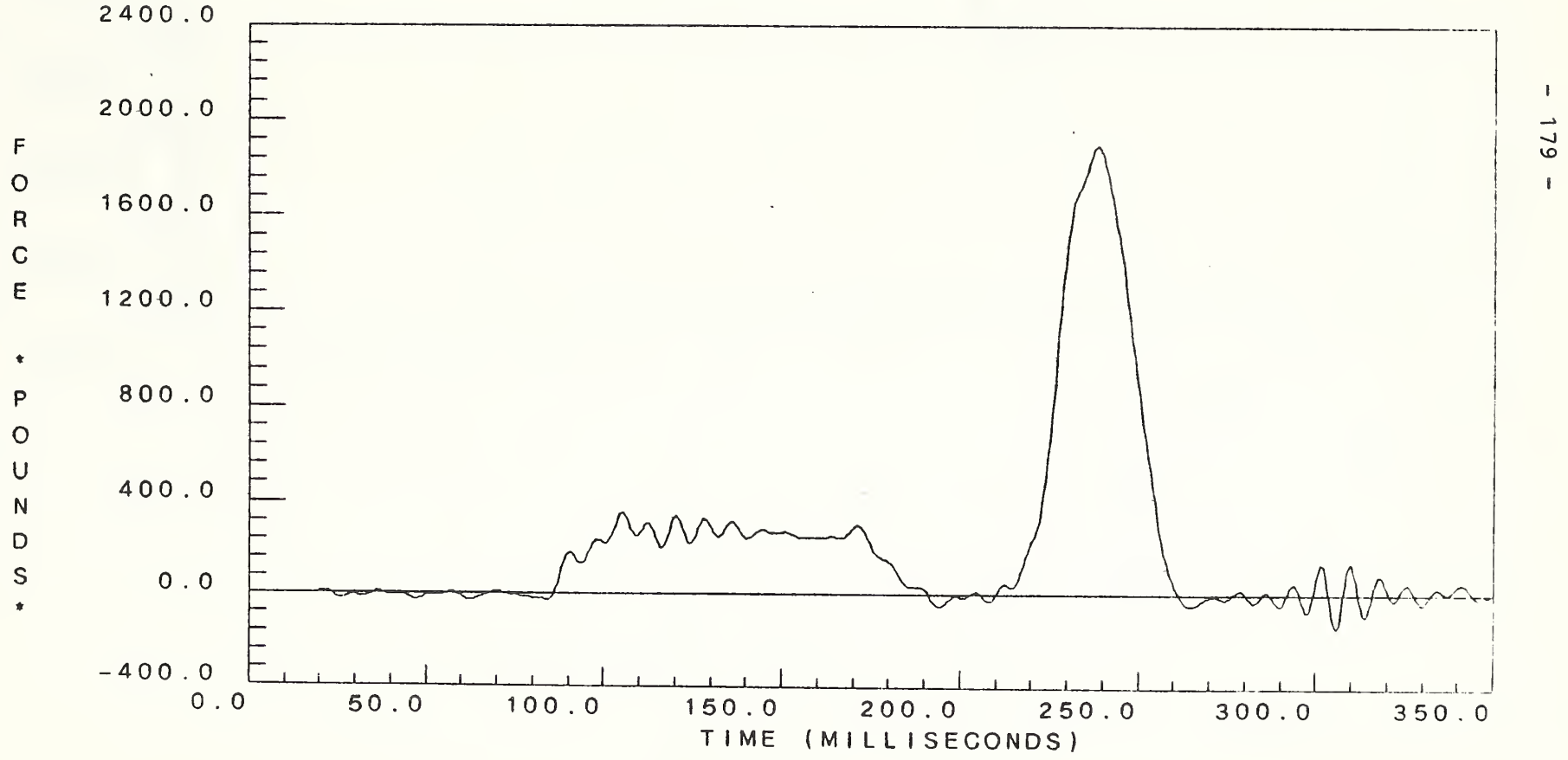
Side Impact Loads

15 MPH Ensolite(6"), Pelvis (Y)



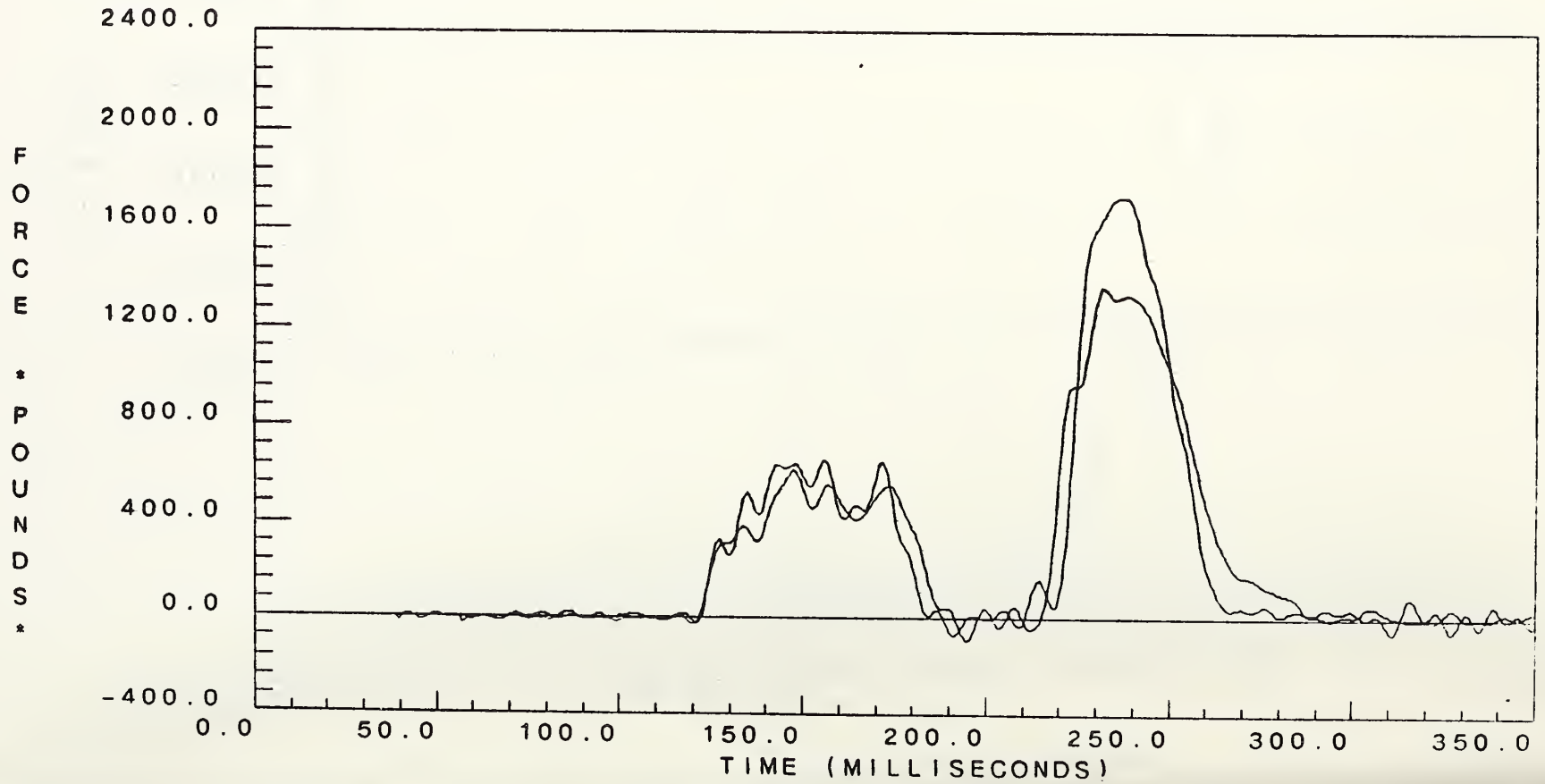
Side Impact Loads

20 MPH Ensolite(6"), Pelvis (Y)



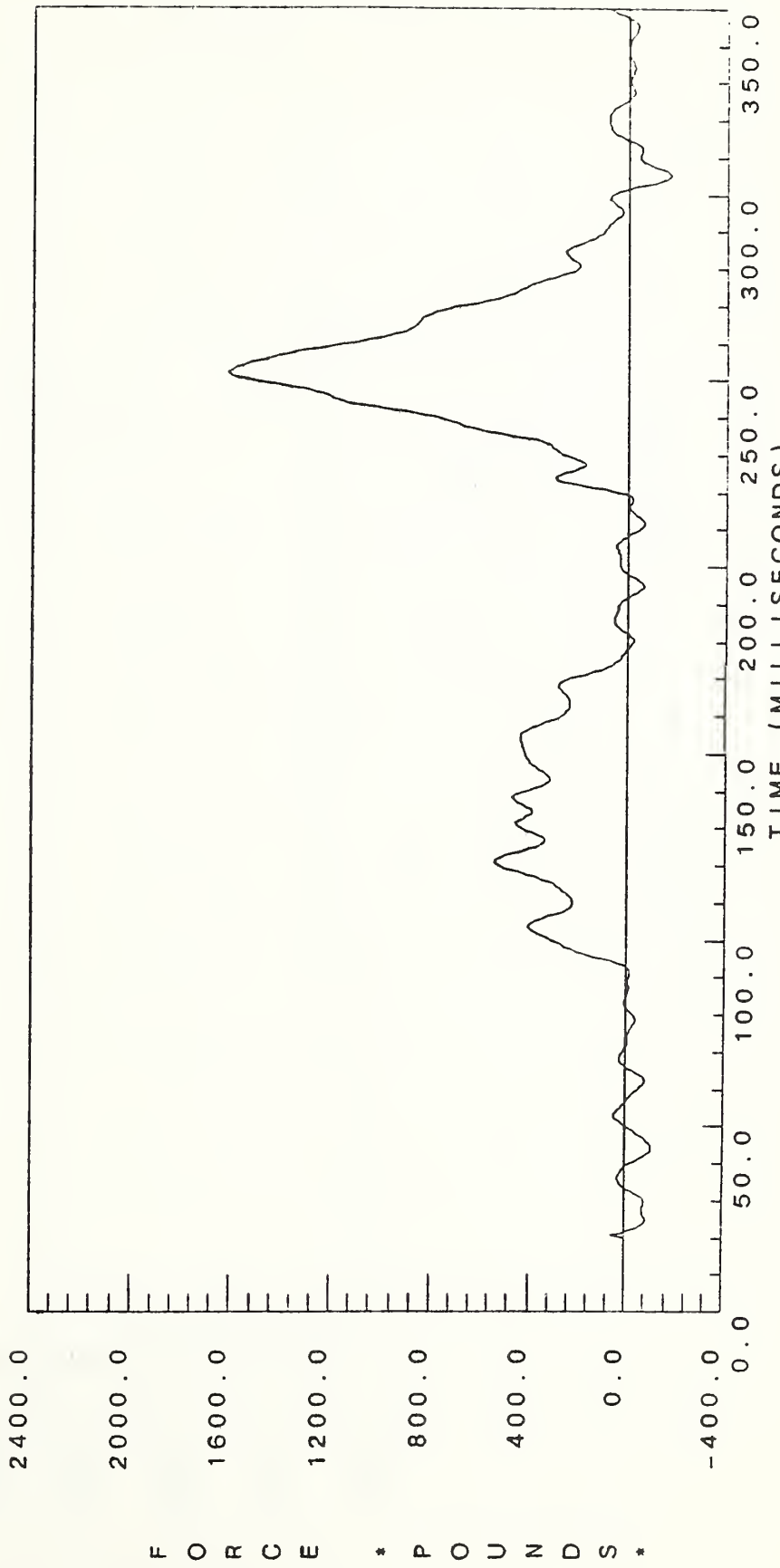
Side Impact Loads

20 MPH Ensolite(12"), Pelvis (Y)



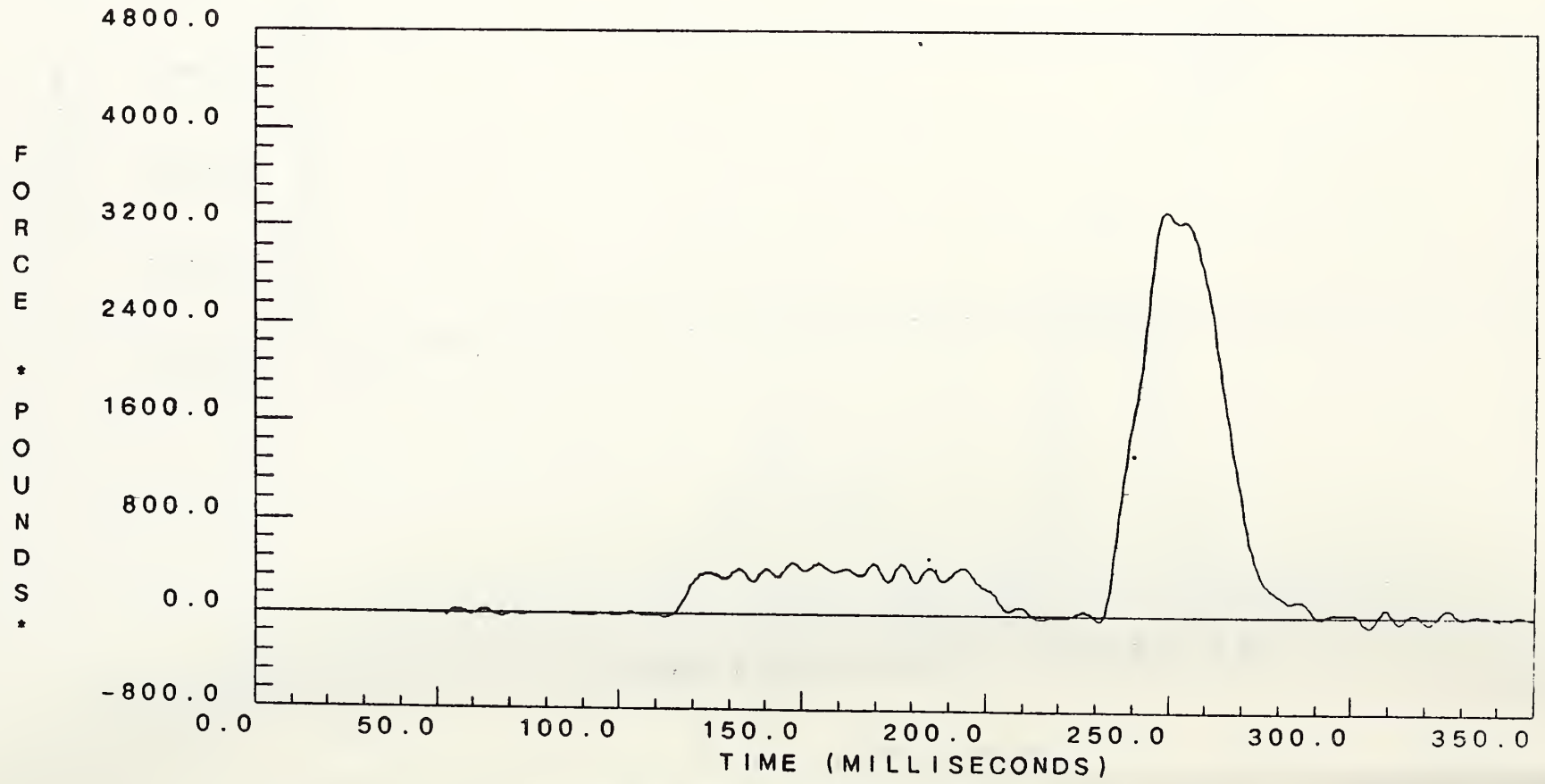
Side Impact

15 MPH Ensolite(6"), Shoulder (Y)



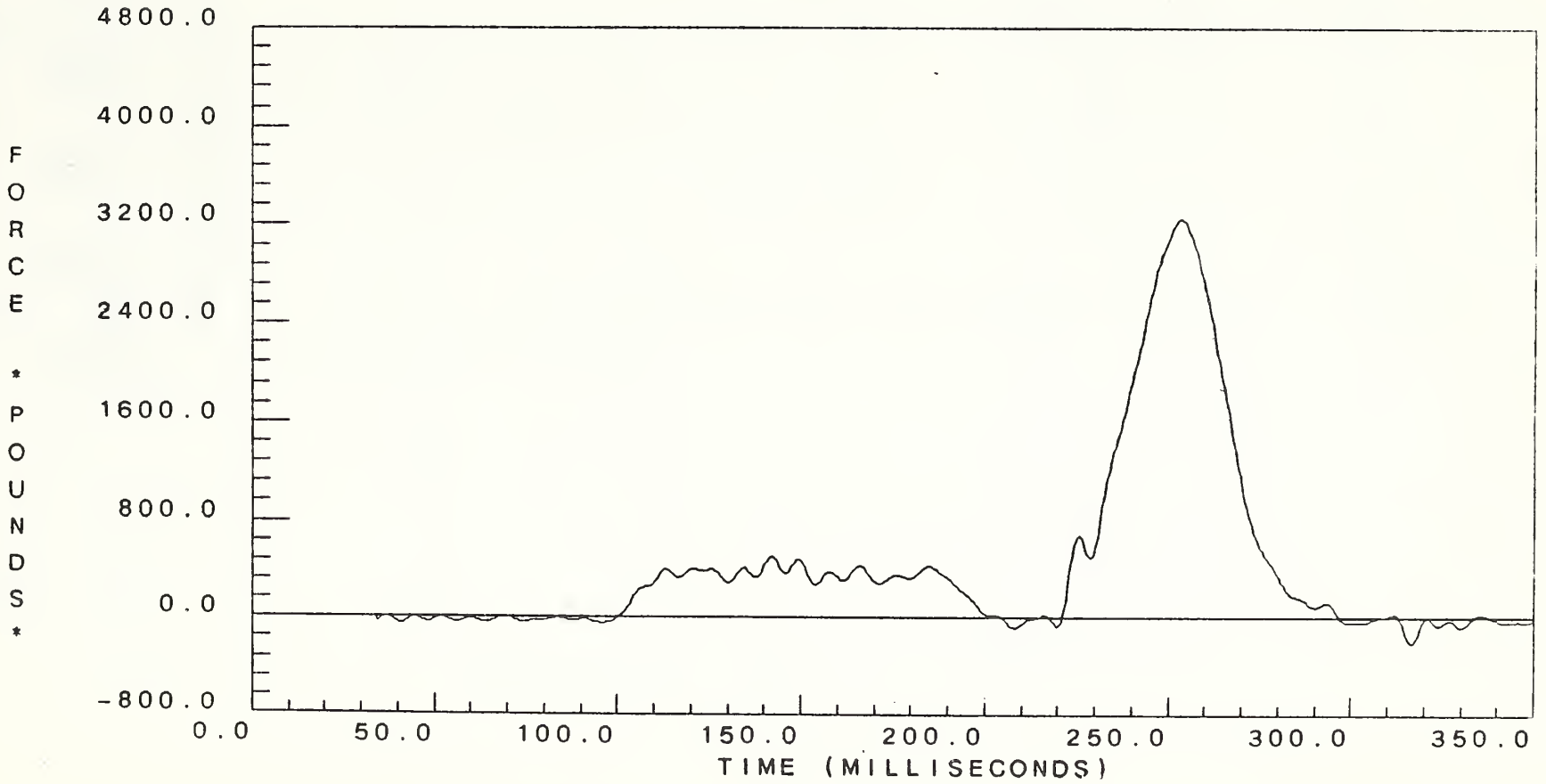
Side Impact

20 MPH Ensolite (1"), Shoulder



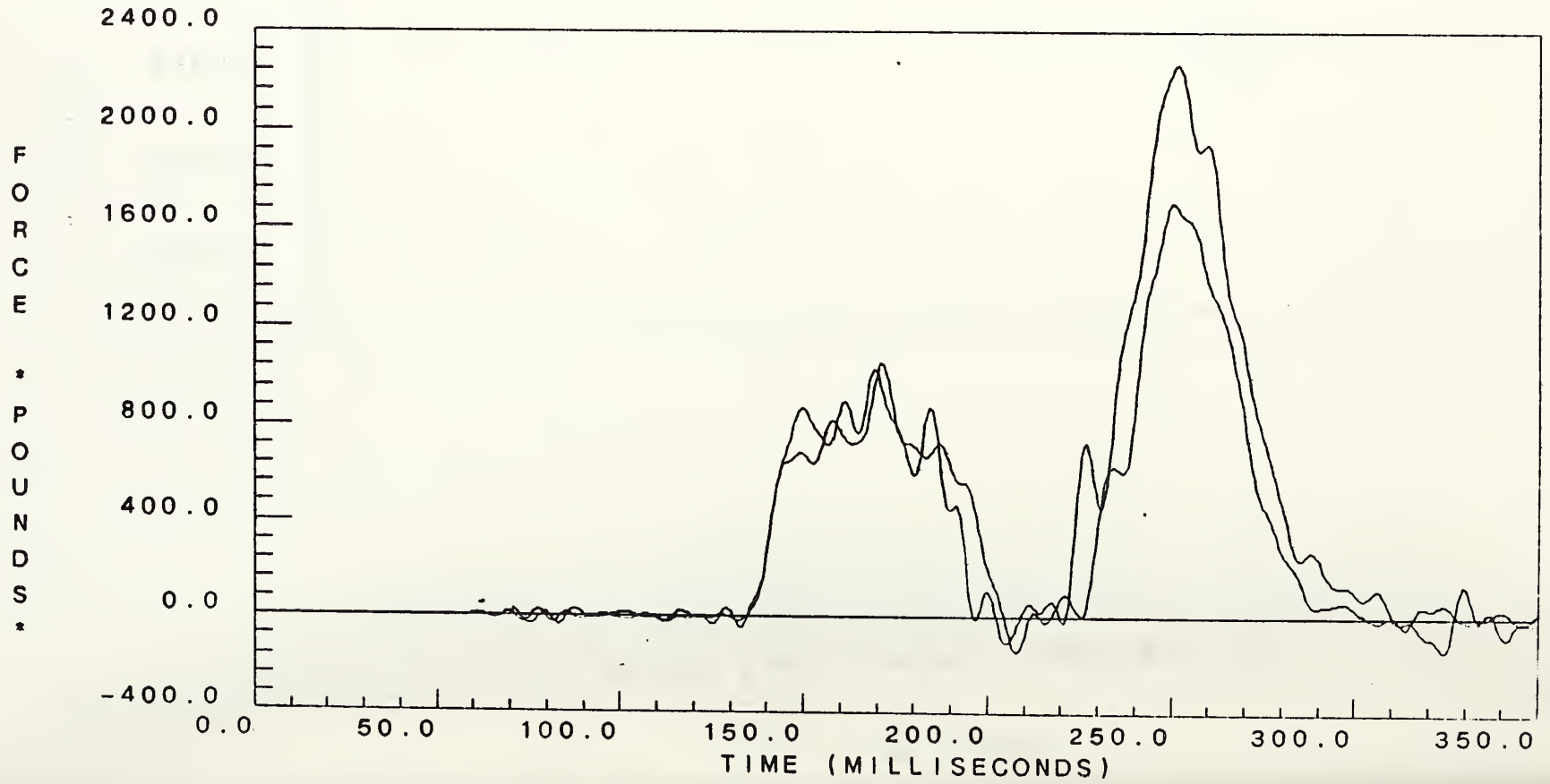
Side Impact

20 MPH Ensolite(6"), Shoulder (Y)



Side Impact

20 MPH Ensolite(12"), Shoulder (Y)



Run No. H8310

a) Subject:
Female, 30 years, body weight 56 kg, body length 176 cm (further anthropometrical data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral collision, 6" US padding (ensolite), impact velocity 27 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder forces, pelvis forces.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	No injuries.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral column:	Laceration of the intervertebral discs C4/C5, C5/C6 dorsal (NILJ2), strain of the posterior longitudinal ligament in the level C4/C5, C5/C6 (NITJ1).
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 0, abdomen 0, pelvis 0, vertebral column 2, extremities 0, MAIS 2.

BENDING TESTS

Run No. H8310

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	296	2,45	34,7
7th rib	280	2,25	46,0

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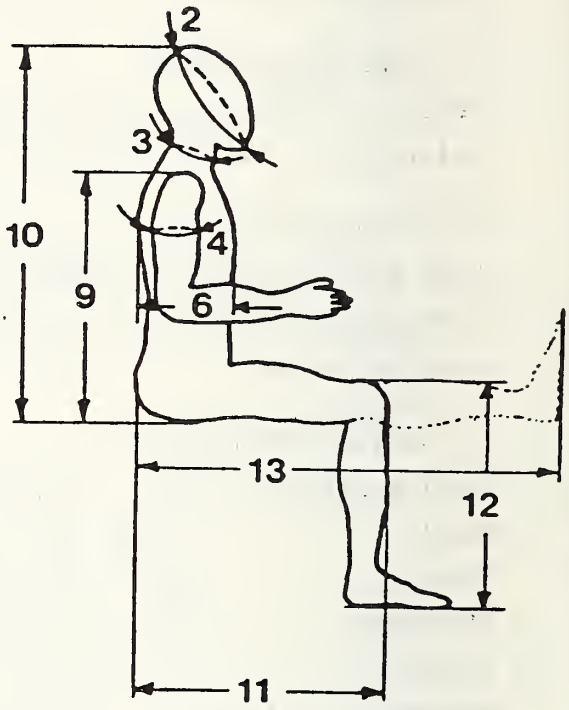
Run No. H 83 1o DOT .....

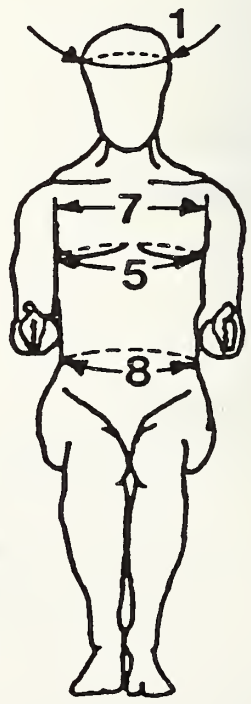
Anthropometrical Data

Body weight ....56 kg

Body length ....176 cm

1. Hat dimension .....54.....cm
2. Head circumference.....57.....cm
3. Neck circumfer. .....32.....cm
4. Upper arm circumfer. .....24.....cm
5. Chest circumfer. .....8o.....cm
6. Chest height .....17.....cm
7. Chest width .....27.....cm
8. Abdomen circumfer. .....78.....cm
9. Buttocks - shoulder .....7o.....cm
10. Seat height .....93.....cm
11. Pelvis - knee .....59.....cm
12. Sole of foot - knee .....52.....cm
13. Pelvis - heal .....1o3.....cm





Run No. H8311

a) Subject:
Male, 26 years, body weight 61 kg, body length 188 cm (further anthropometrical data s. incl.). cause of death: pneumonia.

b) Test conditions:
Lateral collision, 12"US padding (ensolite), impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder forces, pelvis forces.

d) Medical findings:
No injuries.

BENDING TESTS

Run No. H8311

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	163,6	2,2	20,1
7th rib	107,2	3,0	21,1

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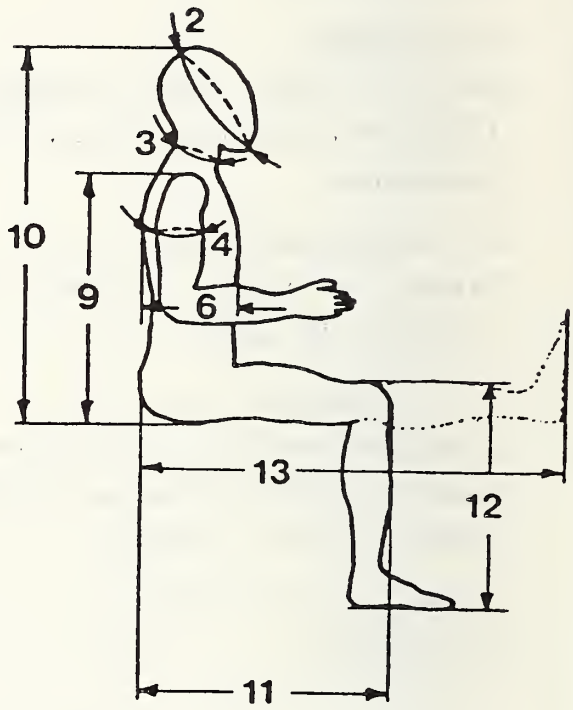
Run No. H 83 11 DOT

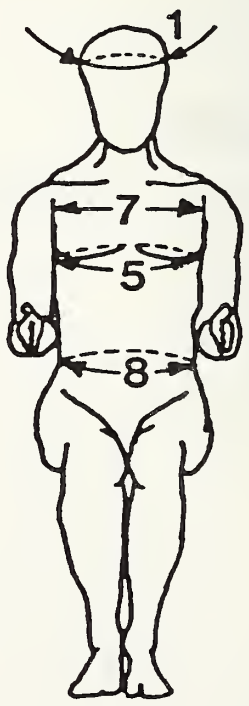
Anthropometrical Data

Body weight ....61 kg

Body length .....188 cm

1. Hat dimension .....56.....cm
2. Head circumference.....62.....cm
3. Neck circumfer. .....31.....cm
4. Upper arm circumfer. .....22.....cm
5. Chest circumfer. .....87.....cm
6. Chest height .....21.....cm
7. Chest width .....31.....cm
8. Abdomen circumfer. .....75.....cm
9. Buttocks - shoulder .....71.....cm
10. Seat height .....96.....cm
11. Pelvis - knee .....65.....cm
12. Sole of foot - knee .....58.....cm
13. Pelvis - heal .....111.....cm





Run No. H8312

a) Subject

Male, 34 years, body weight 77 kg, body length 178 cm (further anthropometrical data s. incl.), cause of death: internal bleeding, liver cirrhosis.

b) Test conditions

Lateral impact, 6" US padding (ensolite), impact velocity 32 km/h.

c) Instrumentation

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder forces, pelvis forces.

d) Medical findings

Body surface:	No injuries.
Head:	No injuries.
Thorax:	No injuries.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral Column:	Strain in the intervertebral disc C2/C3 dorsal and ventral (NSTV1).
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 0, abdomen 0, pelvis 0, vertebral column 1, extremities 0, MAIS 1.

BENDING TESTS

Run No. H8312

	max. Force (N)	max. Defl. (mm)	Cross Section (mm^2)
6th rib	215	5,8	39
7th rib	228	4,0	29

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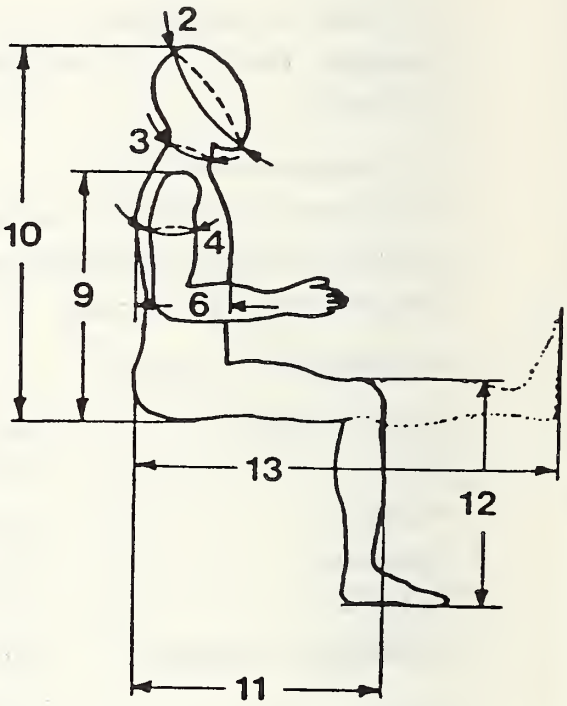
Run No. H 83 12

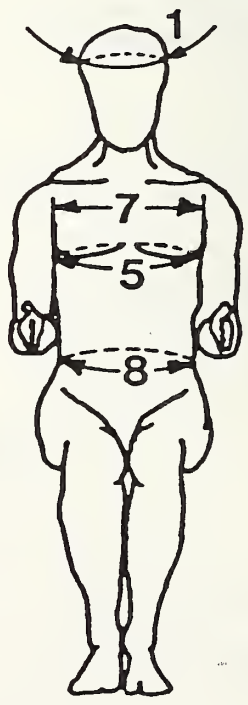
Anthropometrical Data

Body weight ....77.... kg

Body length ....178.... cm

1. Hat dimension .....54.....cm
2. Head circumference.....63.....cm
3. Neck circumfer. .....36.....cm
4. Upper arm circumfer. .....28.....cm
5. Chest circumfer. .....92.....cm
6. Chest height .....22.....cm
7. Chest width .....32.....cm
8. Abdomen circumfer. .....89.....cm
9. Buttocks - shoulder .....76.....cm
10. Seat height .....95.....cm
11. Pelvis - knee .....58.....cm
12. Sole of foot - knee .....53.....cm
13. Pelvis - heal .....1o2.....cm





Run No. H 8320

a) Subject
Female, 17 years, body weight 52 kg, body length 153 cm (further anthropometric data s. incl.), cause of death: acute poisoning.

b) Test conditions
Lateral impact, 12" padding (ensolite), impact velocity 32 km/h.

c) Instrumentation
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, shoulder forces, pelvis forces.

d) Medical findings

Body surface:	No injuries
Head:	No injuries
Thorax:	No injuries
Abdomen:	No injuries
Pelvis:	No injuries
Vertebral Column:	No injuries
Extremities:	No injuries

e) AIS-Severity: Body surface 0, head 0, thorax 0, abdomen 0, pelvis 0, vertebral column 0, extremities 0.

BENDING TESTS

Run No. H 8320

	max. Force (N)	max. Deflex. (mm)	Cross Section (mm^2)
6th rib	240	7,4	35
7th rib	172	8,2	28

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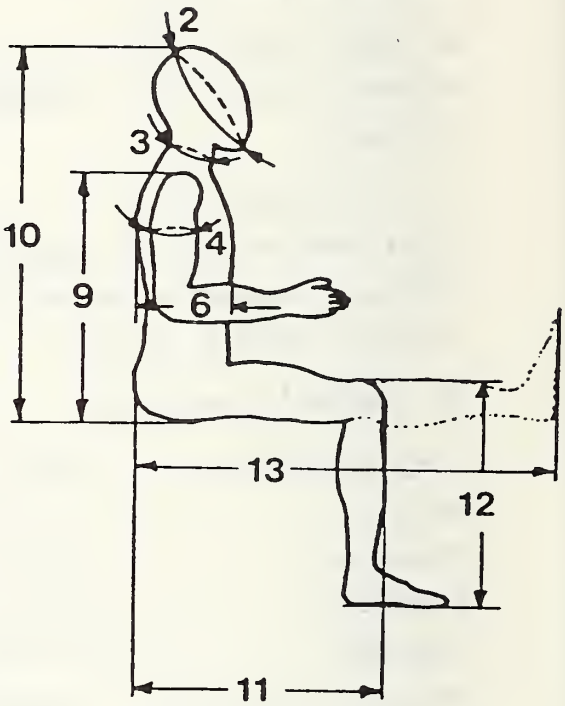
Run No. H 83 20

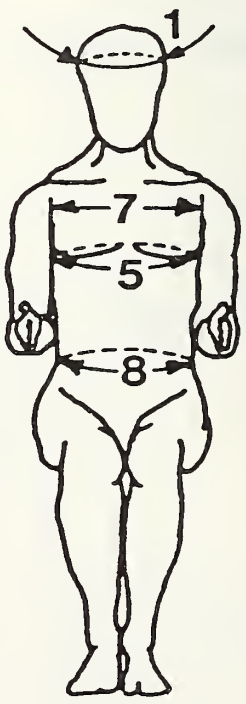
Anthropometrical Data

Body weight ..52.. kg

Body length ..153.. cm

1. Hat dimension .....51.....cm
2. Head circumference.....59.....cm
3. Neck circumfer. .....32.....cm
4. Upper arm circumfer. .....24.....cm
5. Chest circumfer. .....72.....cm
6. Chest height .....18.....cm
7. Chest width .....25.....cm
8. Abdomen circumfer. .....62.....cm
9. Buttocks - shoulder .....62.....cm
10. Seat height .....83.....cm
11. Pelvis - knee .....54.....cm
12. Sole of foot - knee .....45.....cm
13. Pelvis - heal .....88.....cm





Run No. H8408

a) Subject
male, 79 years, body weight 64 kg, body length 168 cm (further anthropometric data s. incl.), cause of death: heart failure.

b) Test Conditions
lateral impact, 2 x 1" Ensolite, impact velocity 32 km/h.

c) Instrumentation
sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces.

d) Medical Findings

Body Surface:	No injuries.
Head:	No injuries.
Thorax:	Fracture of the 1st to 11th rib left paravertebral. Fracture of the 2d to 5th rib in the medium axillar line, of the 6th in the mamilar line and of the 7th to 9th rib in the front axillar line; all fractures left (s. incl.).
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral Column:	Lacerations in the intervertebral discs C1/C2 to Th3/Th4 (NWLJ2, BSLJ2).
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 4, abdomen 0, pelvis 0, vertebral column 2, extremities 0, MAIS 4.

BENDING TESTS

Run No. H8408

	max. Force (N)	max. Defl. (mm)	Cross Section (mm^2)
6th rib	346	3,6	48
7th rib	200	5,0	37

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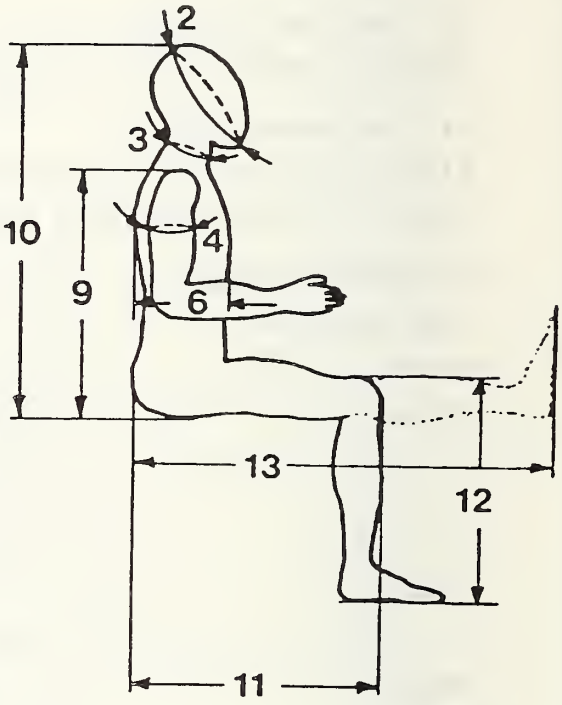
Run No. H.84.08.DOT

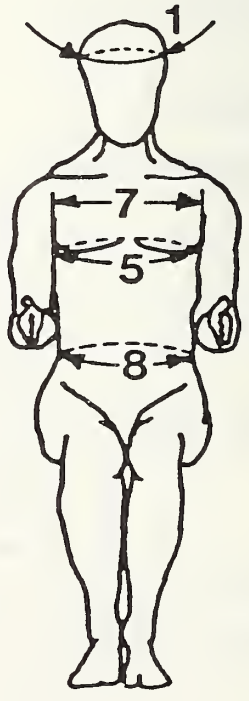
Anthropometrical Data

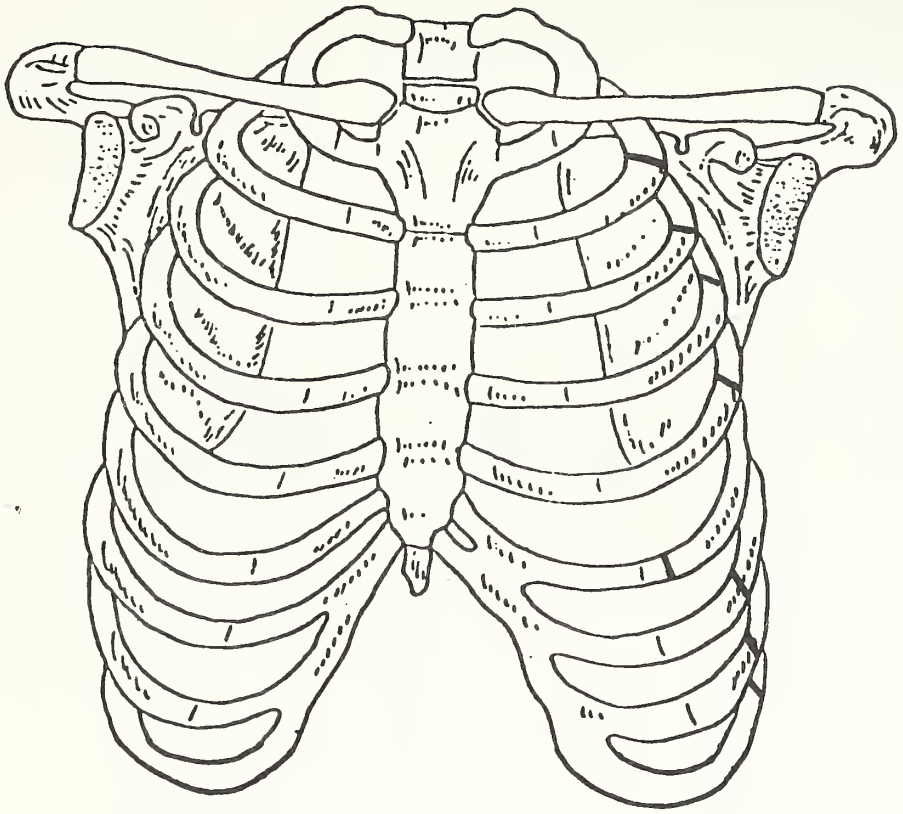
Body weight ..... 64 kg

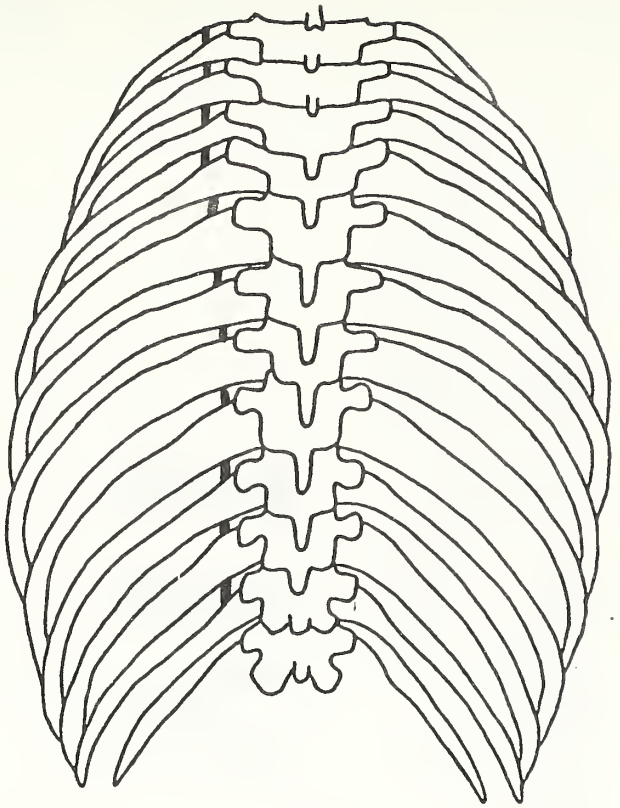
Body length ..... 168 cm

1. Hat dimension ..... 57 cm
2. Head circumference ..... 65 cm
3. Neck circumfer. ..... 42 cm
4. Upper arm circumfer. ..... 30 cm
5. Chest circumfer. ..... 98 cm
6. Chest height ..... 26 cm
7. Chest width ..... 34 cm
8. Abdomen circumfer. ..... 99 cm
9. Buttocks - shoulder ..... 69 cm
10. Seat height ..... 90 cm
11. Pelvis - knee ..... 57 cm
12. Sole of foot - knee ..... 51 cm
13. Pelvis - heal ..... 97 cm









Number of rib fractures 19 .....

APPENDIX VII

LATERAL IMPACT CADAVER TESTS INTO A VOLVO - DOOR

IMPACT VELOCITY :
16/18/27/35 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8308	male	45	78	178	55	63	38	30	100
H 8316	male	52	68	171	55	66	36	29	89
H 8321	male	38	58	165	53	63	36	25	84
H 8330	male	42	86	187	56	68	37	25	97
H 8331	male	43	62	170	54	65	35	25	87
5	M 5 F 0	44	70.4	174.2	54.6	65	36.4	26.8	91.4

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8308	24	33	96	72	95	62	55	102
H 8316	22	30	77	68	92	57	54	101
H 8321	21	29	79	67	92	53	49	91
H 8330	24	34	89	74	98	65	58	108
H 8331	24	30	77	68	90	58	53	97
5	23	31.2	83.6	69.8	93.4	59	53.8	99.8

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8308	Volvodoor	15	0	0	0	0	0	0	0
H 8316	Volvodoor	35	13	9	4	5	4	2	2
H 8321	Volvodoor	36	24	20	8	12	4	4	0
H 8330	Volvodoor	18	0	0	0	0	0	0	0
H 8331	Volvodoor	27	13	13	0	13	0	0	0
5	Volvodoor	26.4	10	8.4	2.4	6	1.6	1.2	.4

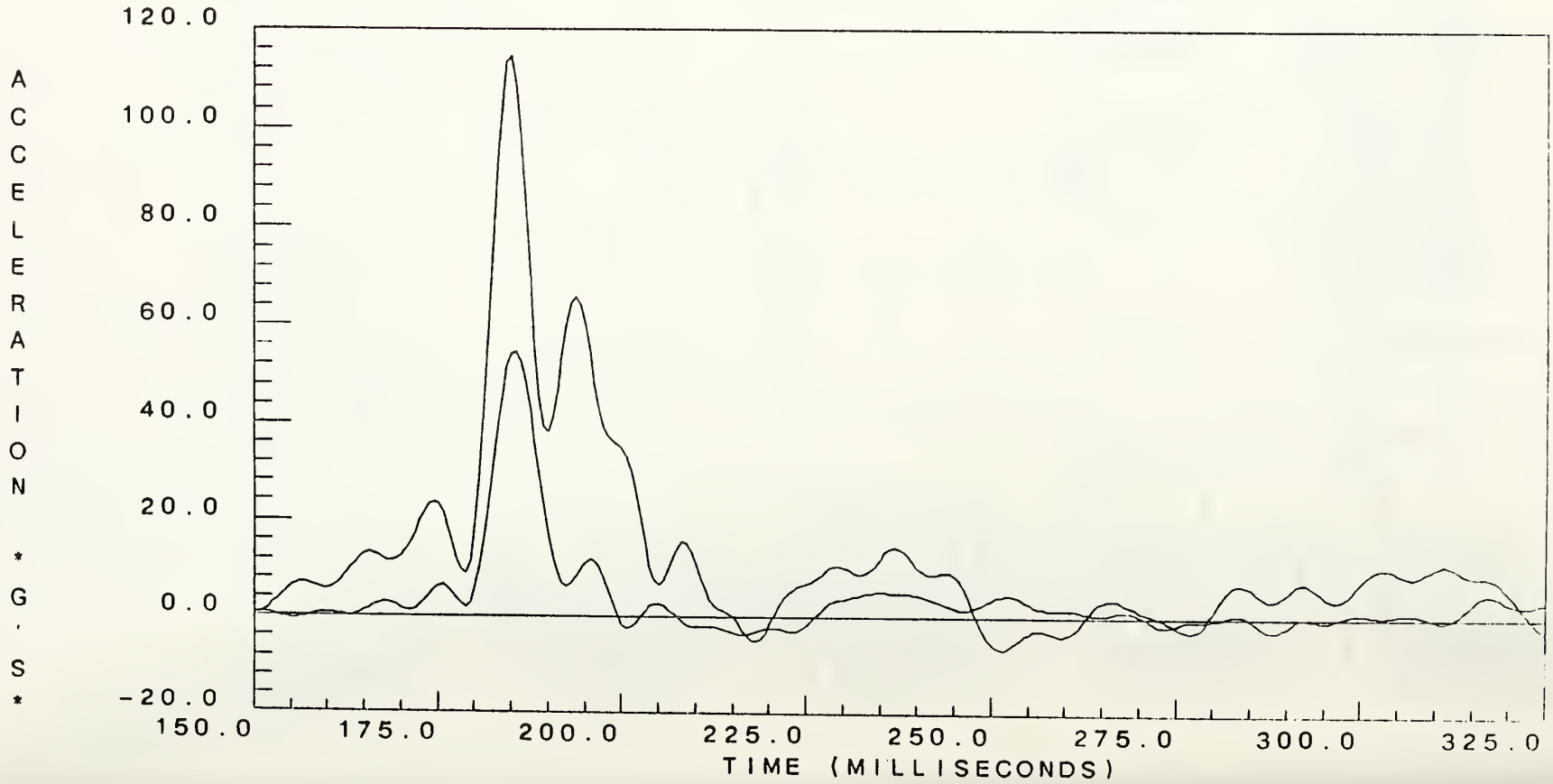
AIS - SEVERITY

Run No	Body Sur-face	Head	Thorax	Abdomen	Pelvis	Spine	Extrem .	MAIS
H 8308	0	0	0	0	0	0	0	0
H 8316	0	3	4	0	0	1	0	4
H 8321	0	3	4	0	2	0	0	4
H 8330	0	0	0	0	0	0	0	0
H 8331	1	1	3	0	0	1	1	3
5	.2	1	2	0	.4	.4	.2	2

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
H 8308	114	3.7	35.2	138	4.7	28.4
H 8316	180	4.4	23	150	3.6	26
H 8321	96	3.0	32	89	3.0	27
H 8330	213	3.4	32	333	4.0	40
H 8331	115	3.2	22	131	2.5	22
5	143.6	3.54	28.84	168.2	3.56	28.68

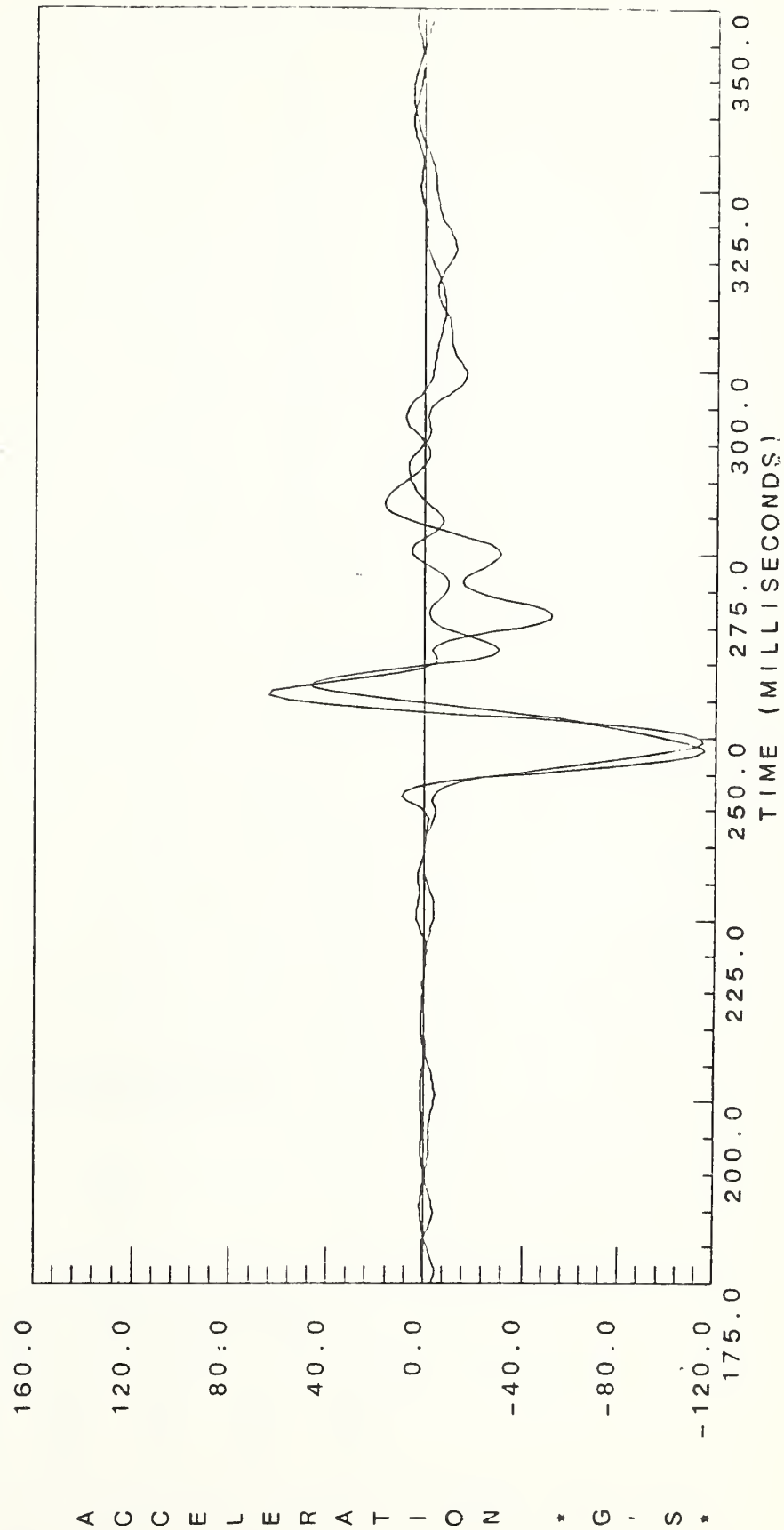
Side Impact

10 MPH Volvo Door, Lower Rib (Y)



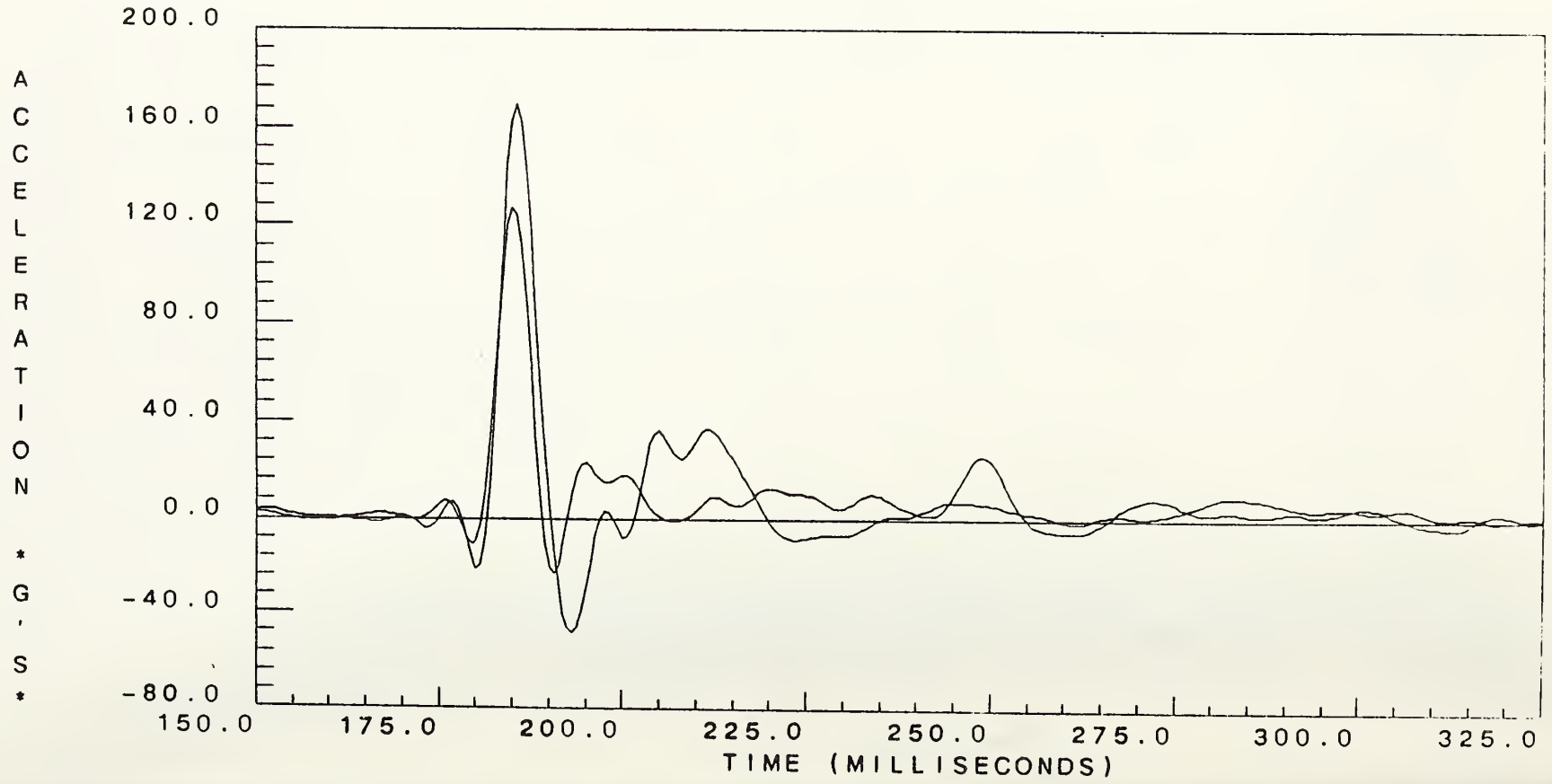
Side Impact

20 MPH Volvo Door, Upper Rib (Y)



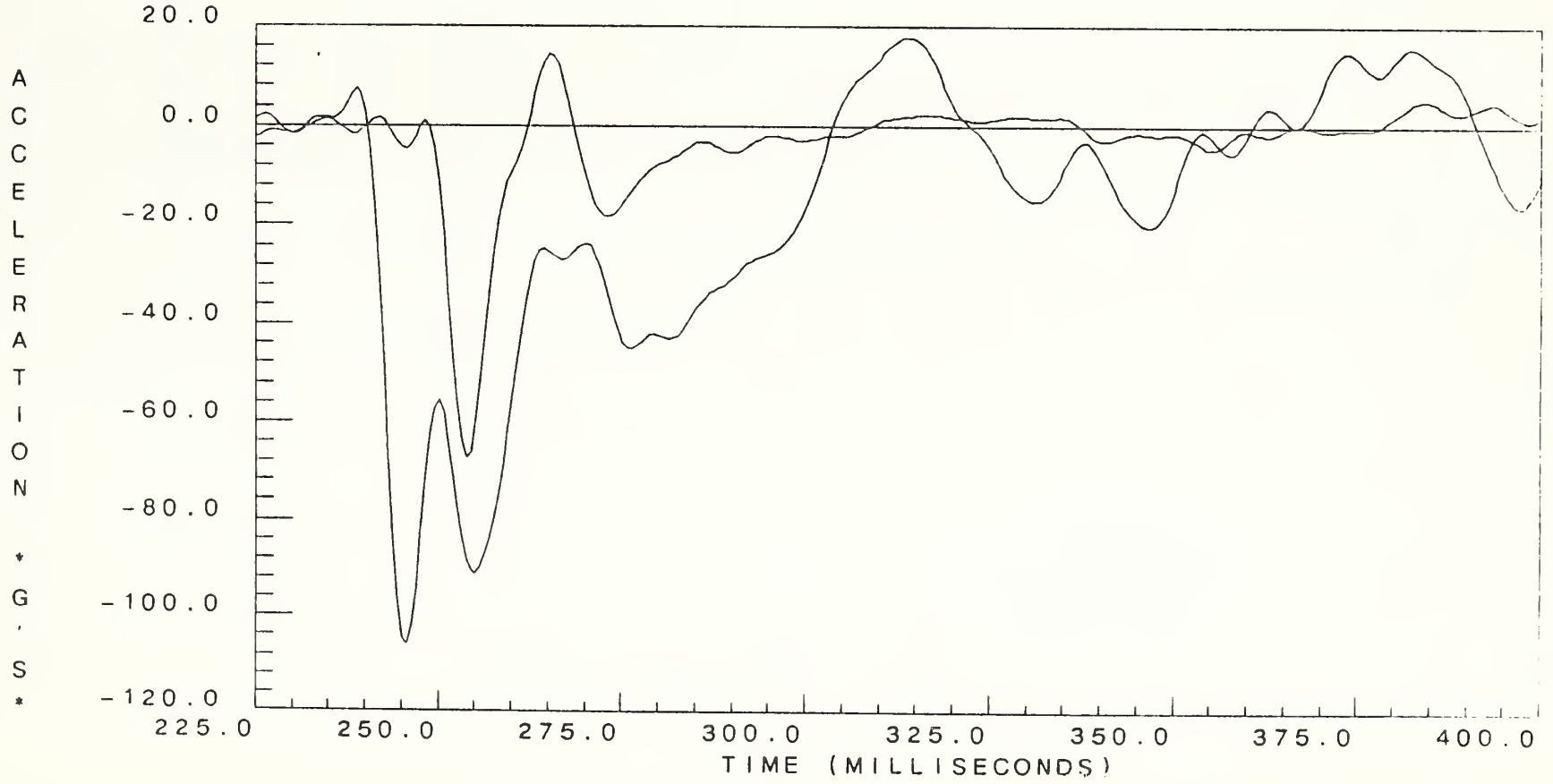
Side Impact

20 MPH Volvo Door, Lower Rib (Y)



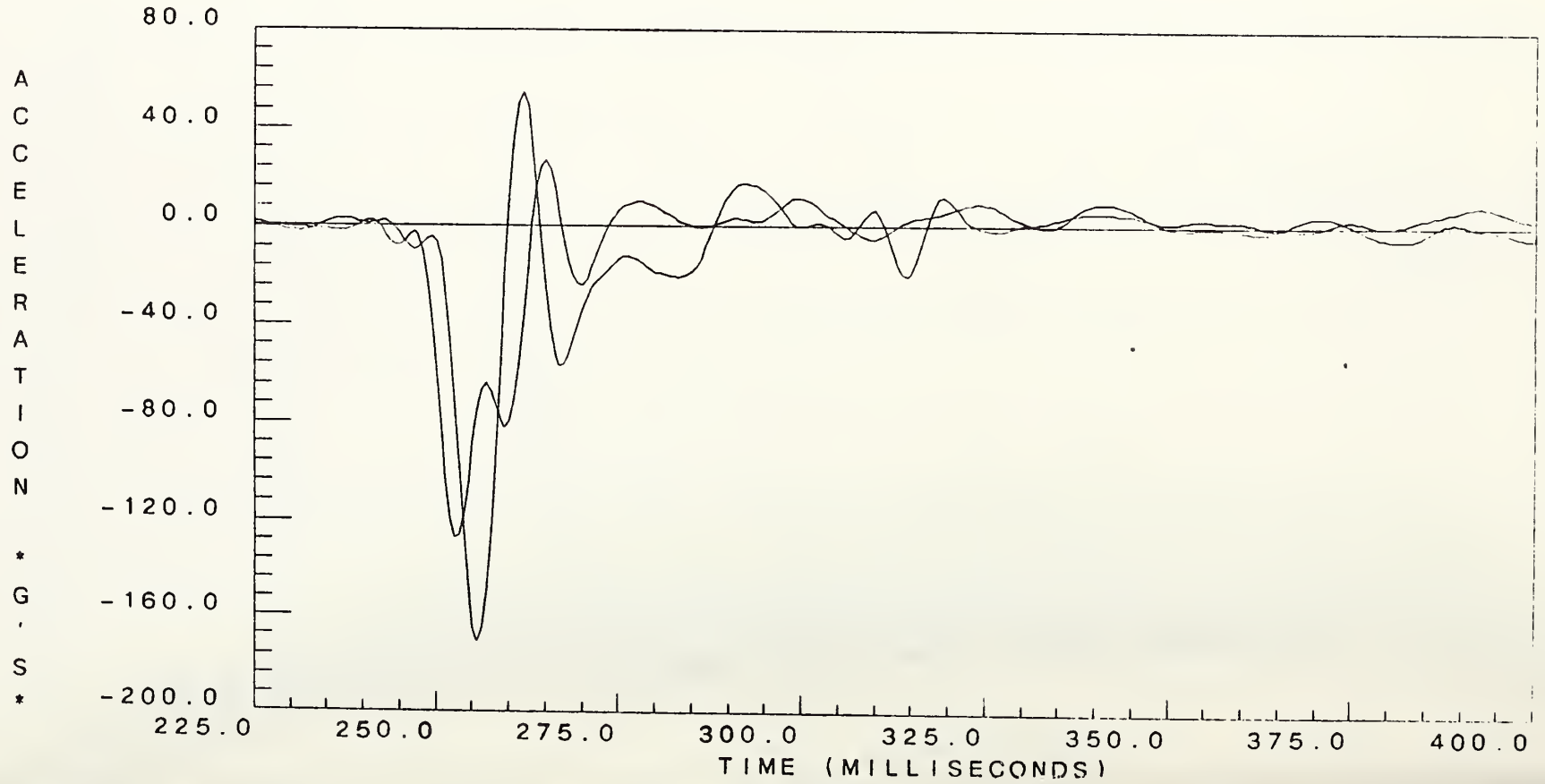
Side Impact

10 MPH Volvo Door, Upper Spine (Y)



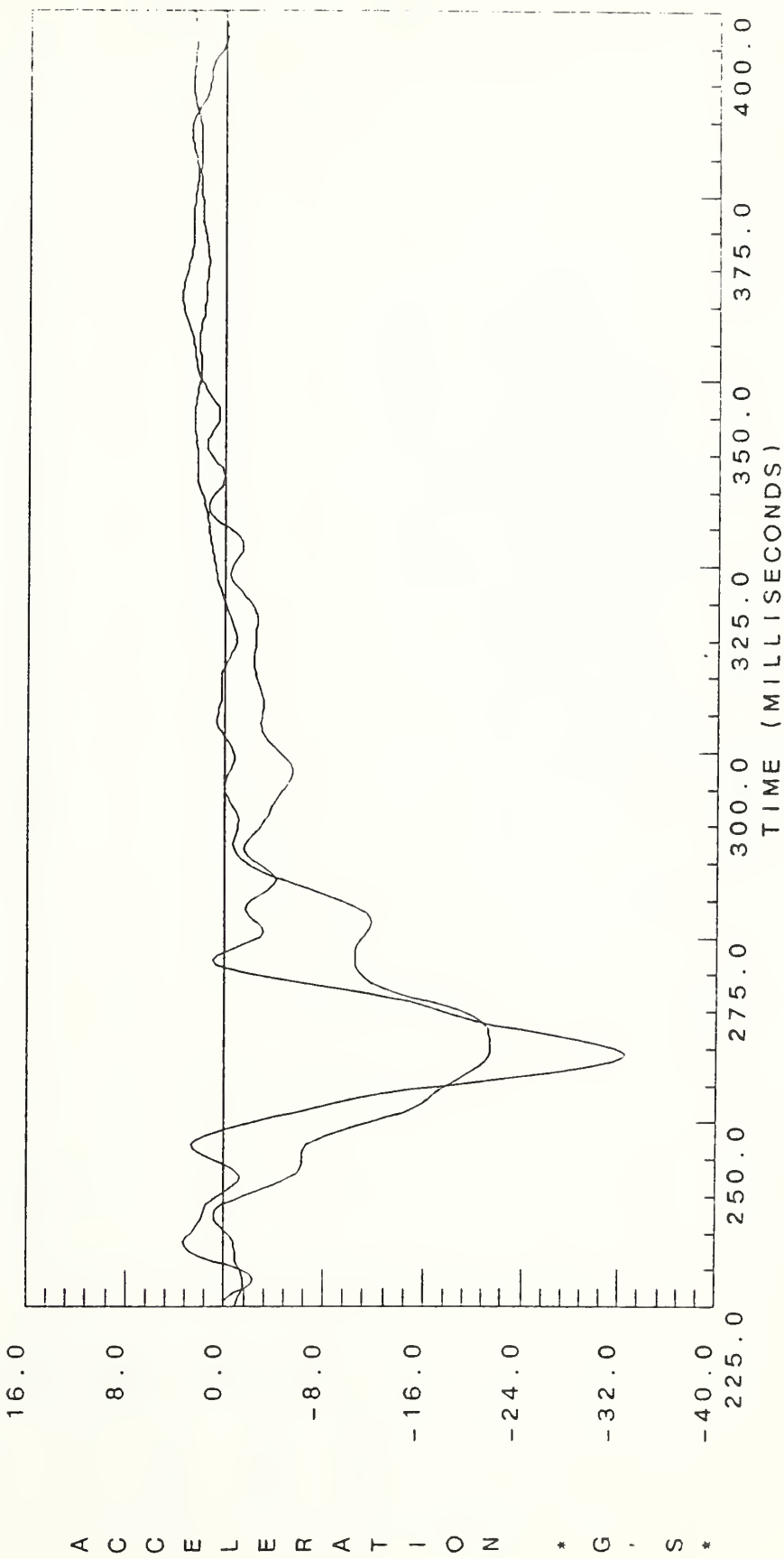
Side Impact

20 MPH Volvo Door, Upper Spine (Y)



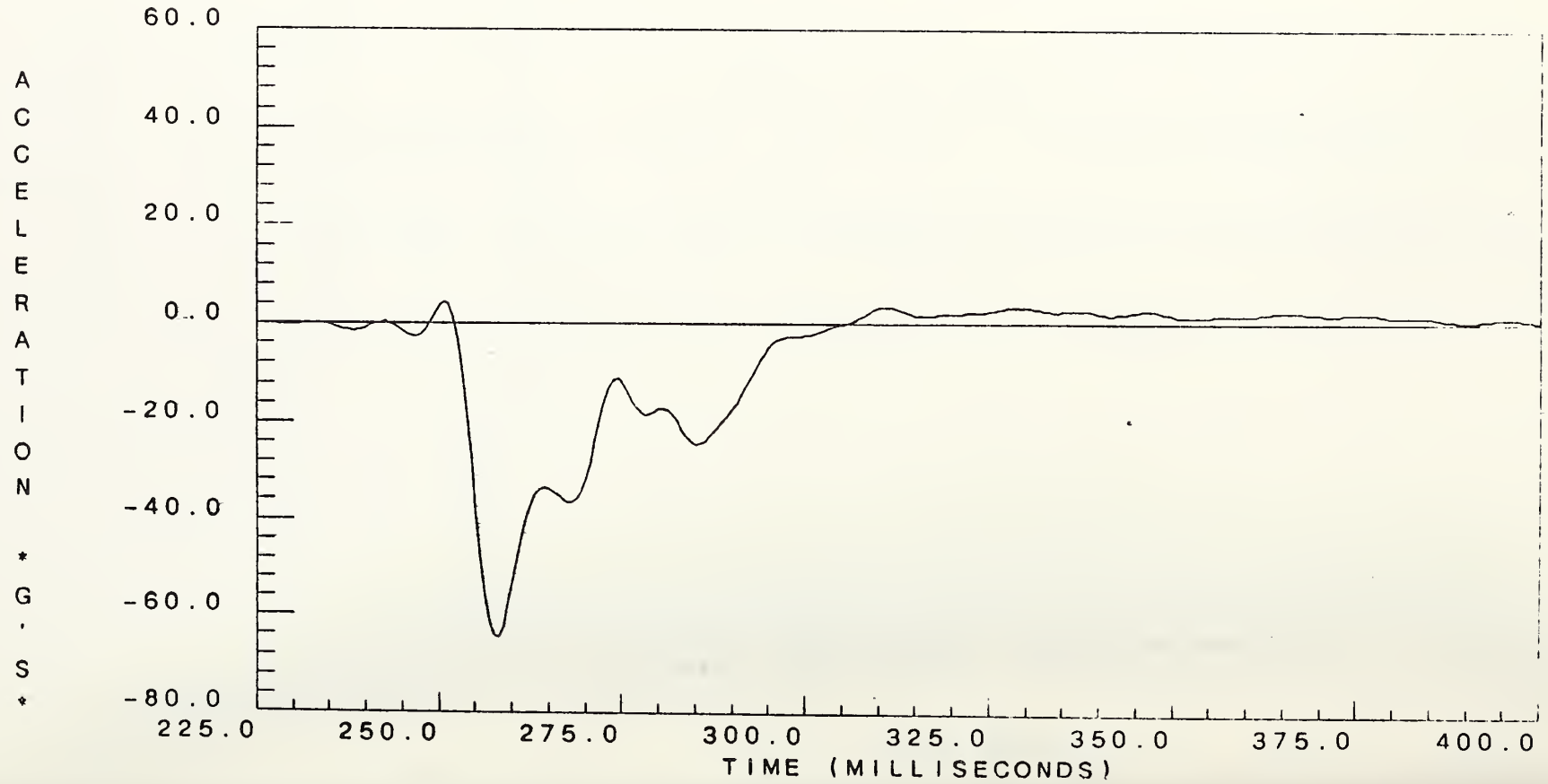
Side Impact

10 MPH Volvo Door, Lower Spine (Y)



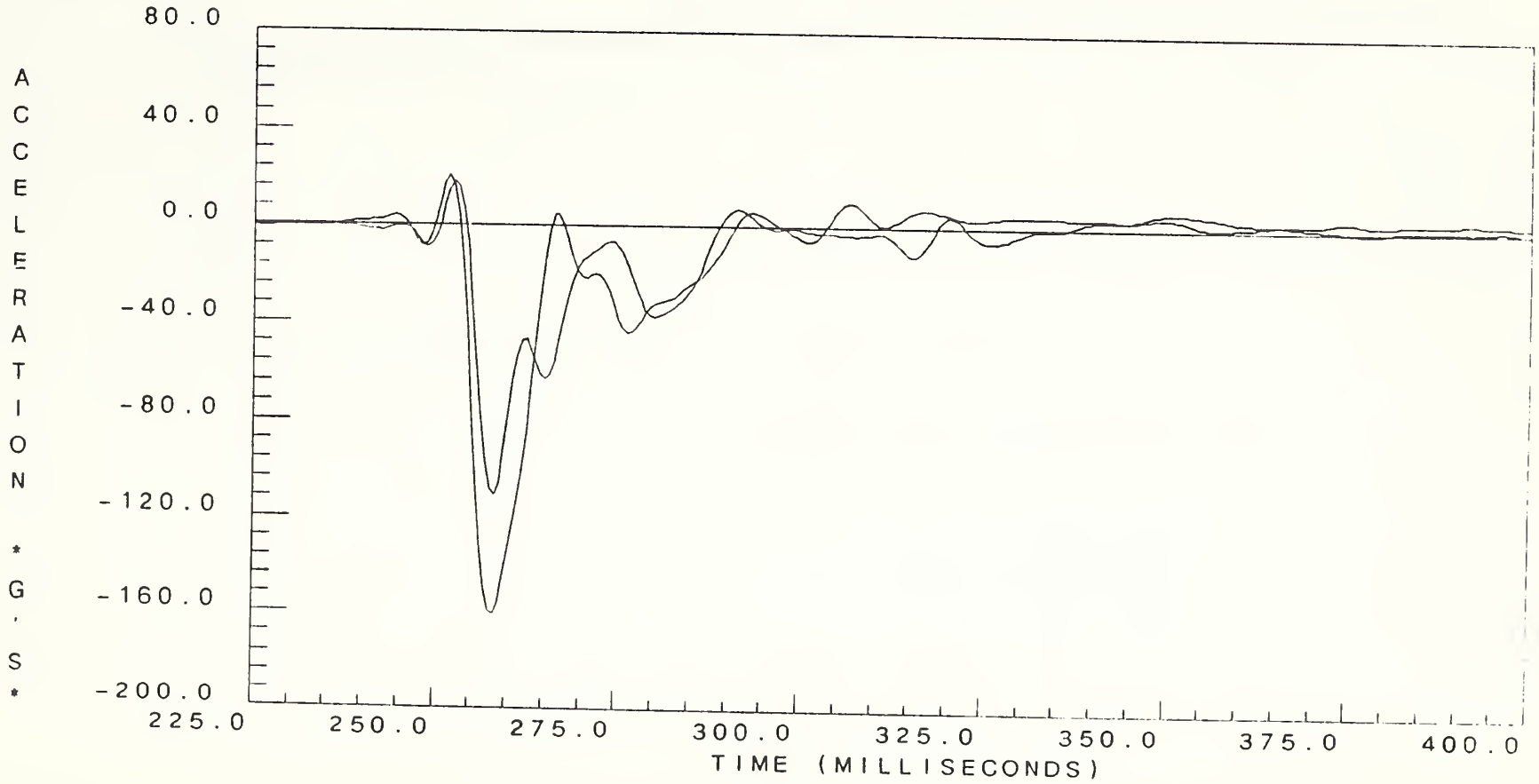
Side Impact

15 MPH Volvo Door, Lower Spine (Y)



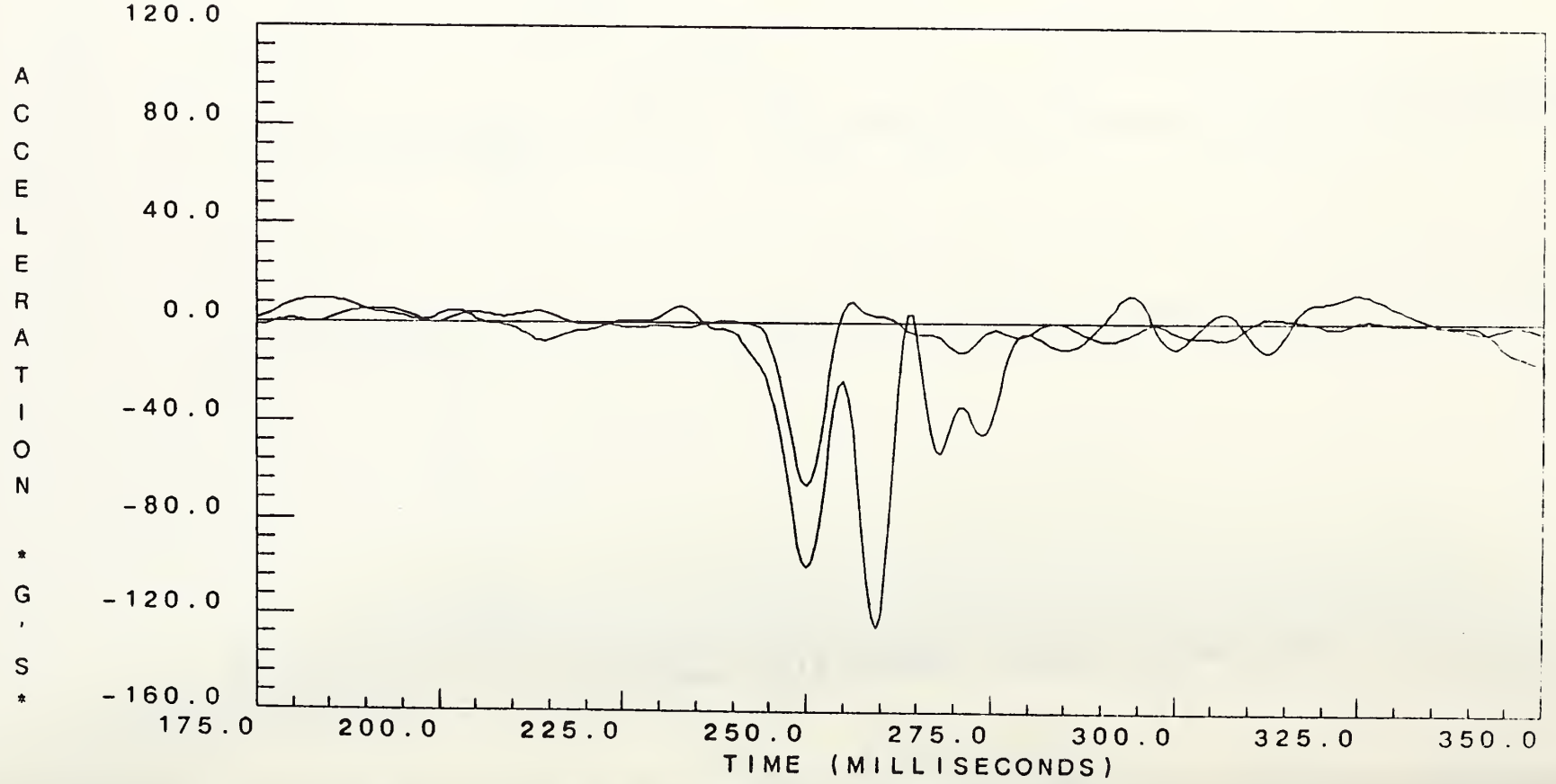
Side Impact

20 MPH Volvo Door, Lower Spine (Y)



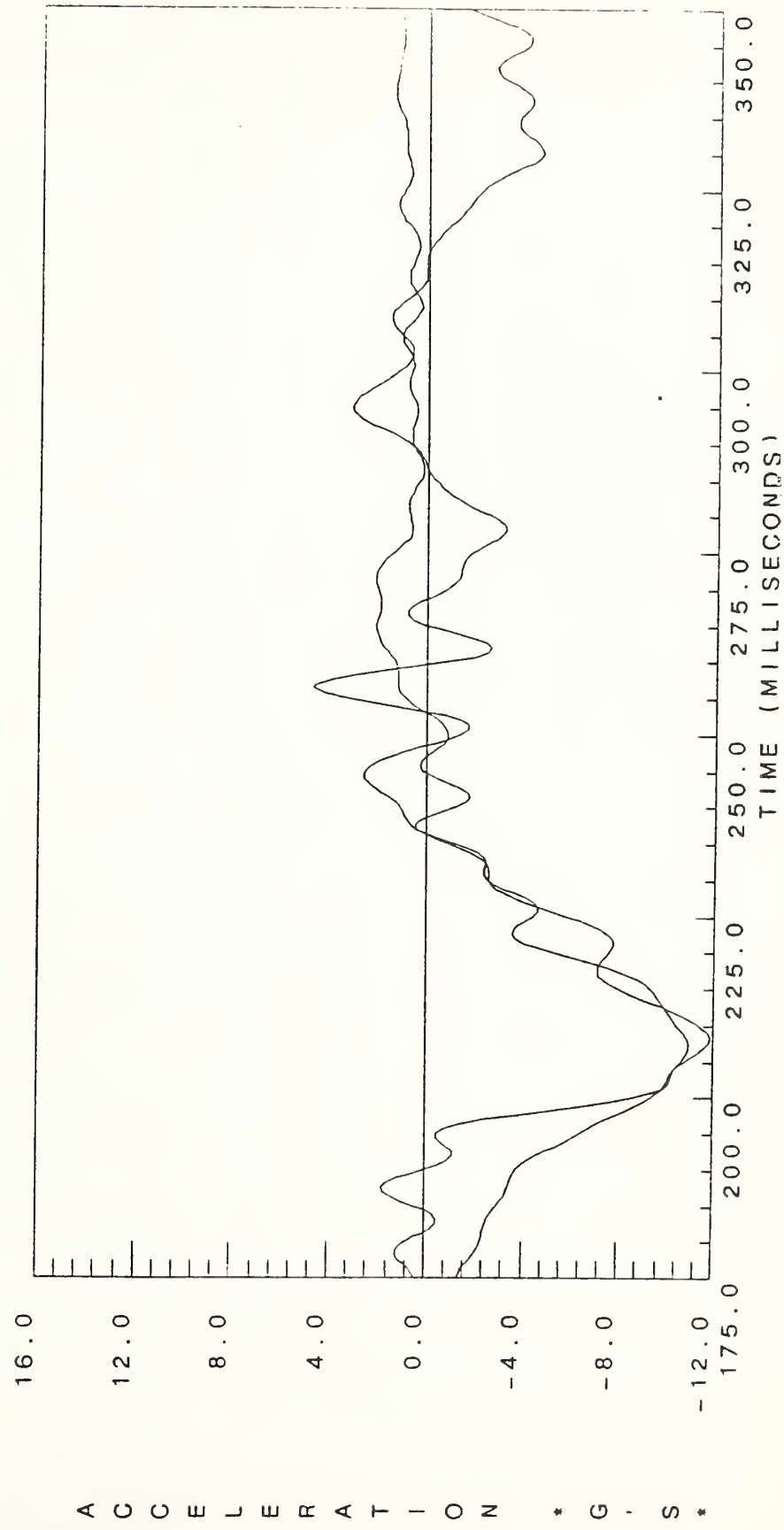
Side Impact

10 MPH Volvo Door, Upper Rib (Y)



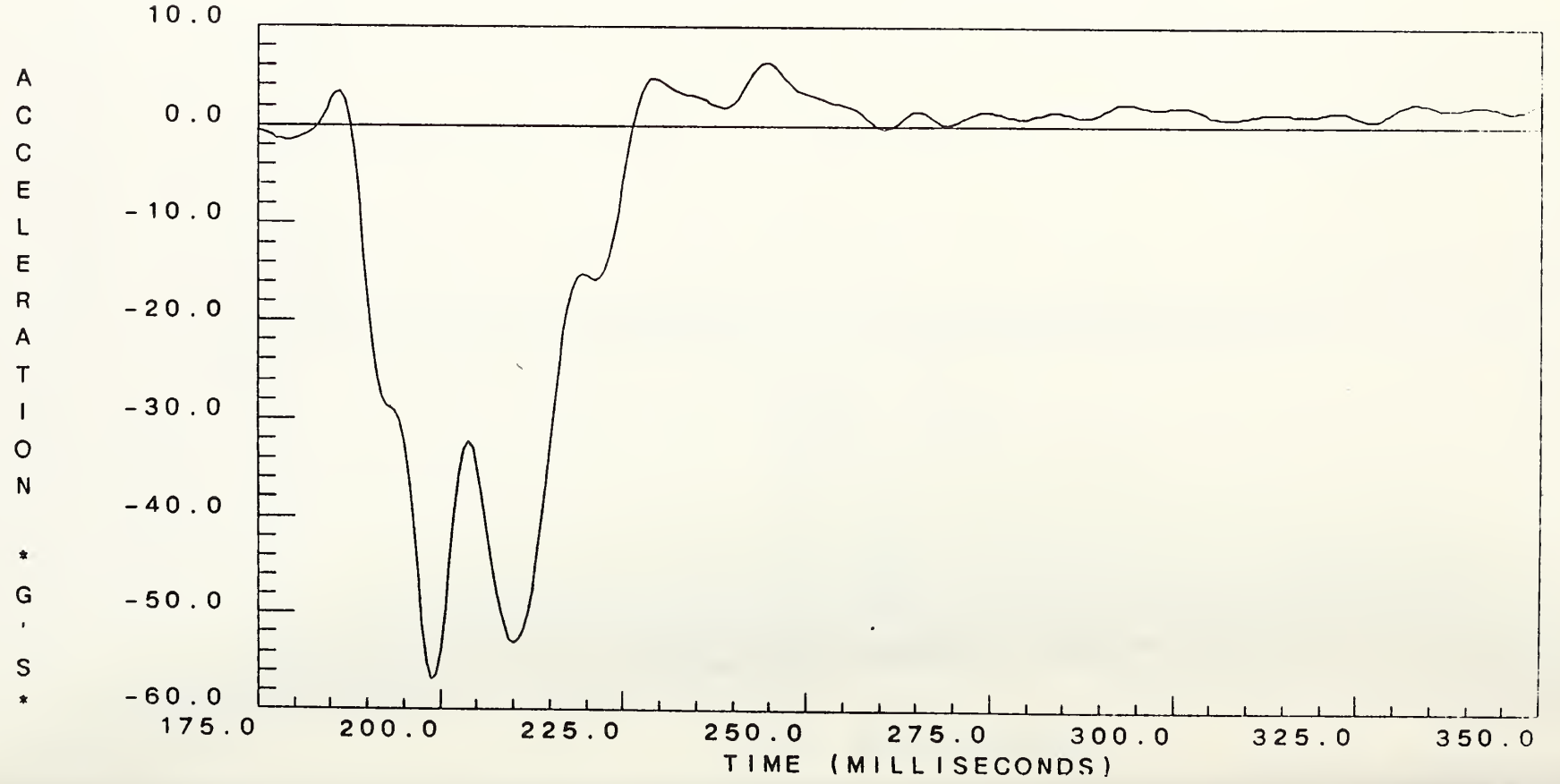
Side Impact

10 MPH Volvo Door, Pelvis (Y)



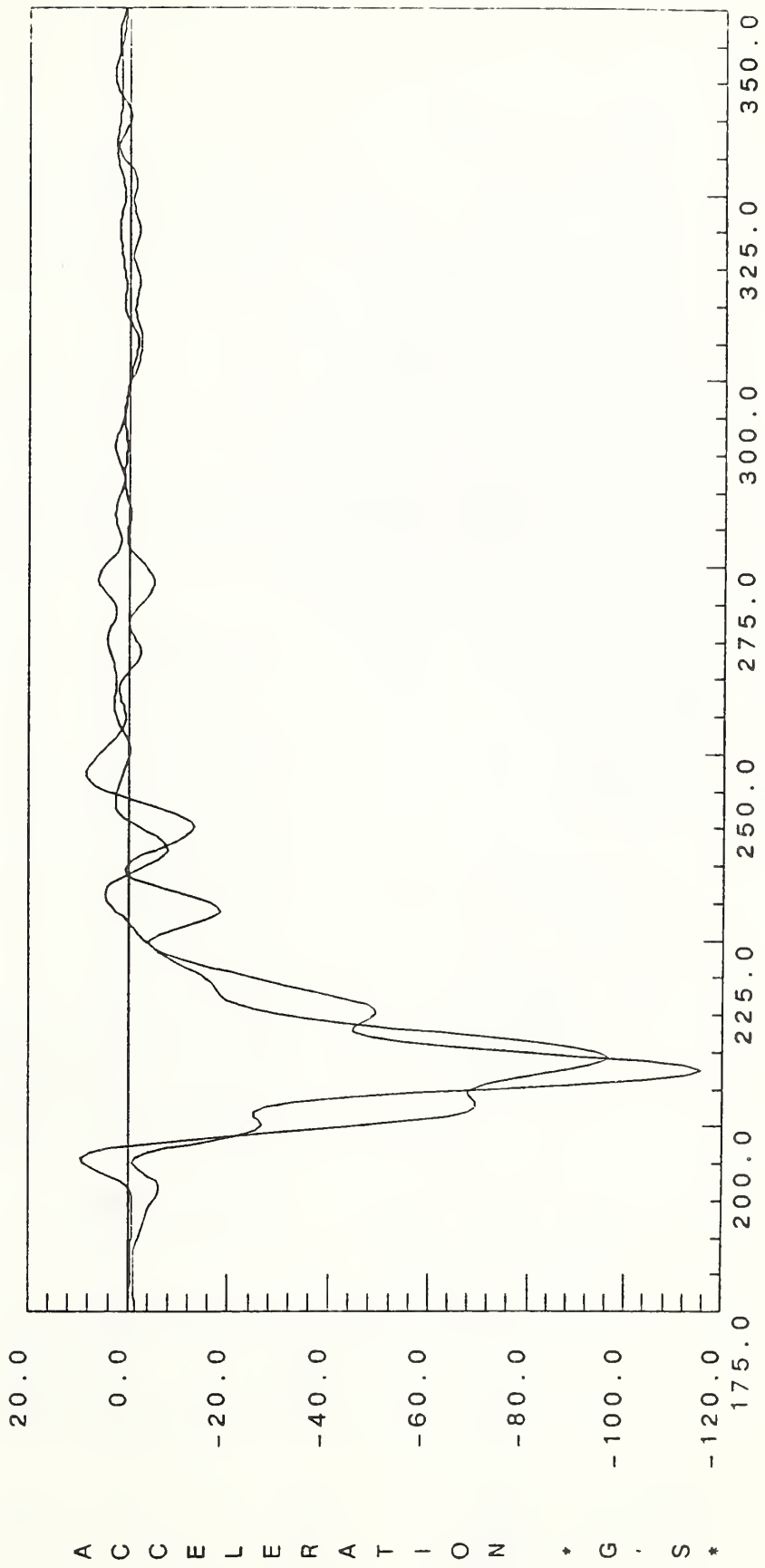
Side Impact

15 MPH Volvo Door, Pelvis (Y)



Side Impact

20 MPH Volvo Door, Pelvis (Y)



Run No. H 8308

a) Subject:
Male, 45 years of age, body weight 78 kg, body length 178 cm (further anthropometric data s. incl.), cause of death: heart failure.

b) Test conditions:
Lateral collision, Volvo door, impact velocity 16 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body surface:	No injuries.
Head:	No injuries.
Thorax:	No injuries.
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral Column:	No injuries.
Extremities:	No injuries.
e) AIS-Severity:	Body surface 0, head 0, thorax 0, abdomen 0, pelvis 0, vertebral column 0, extremities 0, MAIS 0.

BENDING TESTS

Run No. H 8308

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	114	3,7	35,2
7th rib	138	4,7	28,4

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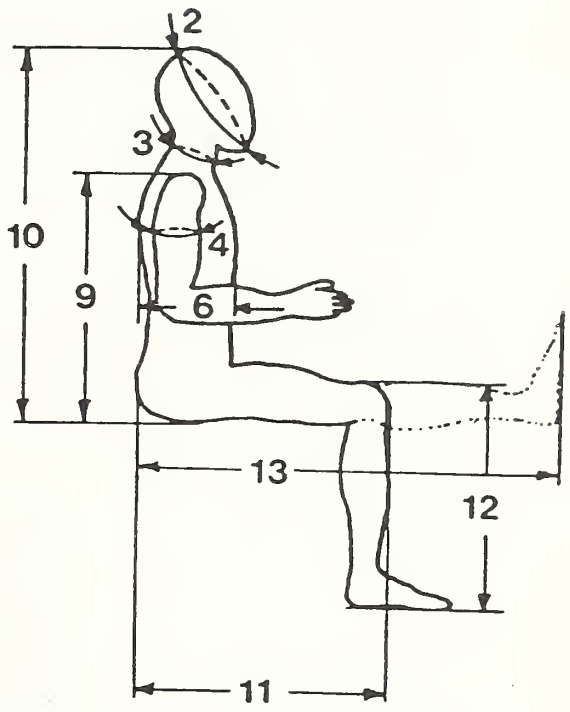
Run No. H 83 08...

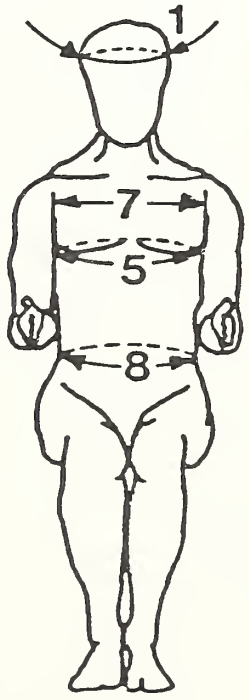
Anthropometrical Data

Body weight ....78.... kg

Body length ....178.... cm

1. Hat dimension .....55.....cm
2. Head circumference.....63.....cm
3. Neck circumfer. .....38.....cm
4. Upper arm circumfer. .....38.....cm
5. Chest circumfer. .....1oo.....cm
6. Chest height .....24.....cm
7. Chest width .....33.....cm
8. Abdomen circumfer. .....96.....cm
9. Buttocks - shoulder .....72.....cm
10. Seat height .....95.....cm
11. Pelvis - knee .....62.....cm
12. Sole of foot - knee .....55.....cm
13. Pelvis - heal .....1o2.....cm





Run No. H8316

a) Subject

Male, 52 years, body weight 68 kg, body length 171 cm (further anthropometrical data s. incl.), cause of death: drown.

b) Test conditions

Lateral impact, Volvo door, impact velocity 35 km/h.

c) Instrumentation

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings

Body surface:	No injuries.
Head:	Fracture of the temporal and parietal bone left. The fracture continued in the base of the scull close to the petrosal bone left.
Thorax:	Muscle strain in the lower scapula area left. Muscle strain at the thorax left. Fracture of the clavicle left in the outer third part; muscle laceration in this area. Rib fractures left; 2nd to 5th rib paravertebral, 2nd rib in the rear axillar line, 3d to 6th rib in the medium axillar line, with transfixing of the 5th and 6th rib in the pleura. Rib fractures right: 2nd and 3rd rib in the medium axillar line, 4th and 5th in the medium scapular line (incl.).
Abdomen:	No injuries.
Pelvis:	No injuries.

Vertebral Column: Muscle strain at the neck left. Strain in the intervertebral disc C5/C6 dorsal (NPTV1). Strain in the dorsal quarter of the intervertebral disc L1/L2 with strain of the anulus fibrosus from the lower vertebral surface L1(BPTV1).
Strain in the lateral joint and the foramen intervertebral Th1/Th2 right (BLTJ1, BSTJ1).

Extremities: No injuries.

e) AIS-Severity: Body surface 0, head 3, thorax 4, abdomen 0, pelvis 0, vertebral column 1, extremities 0, MAIS 4.

BENDING TESTS

Run No. H8316	max. Force (N)	max. Defl. (mm)	Cross Section (mm^2)
6th rib	180	4,4	23
7th rib	150	3,6	26

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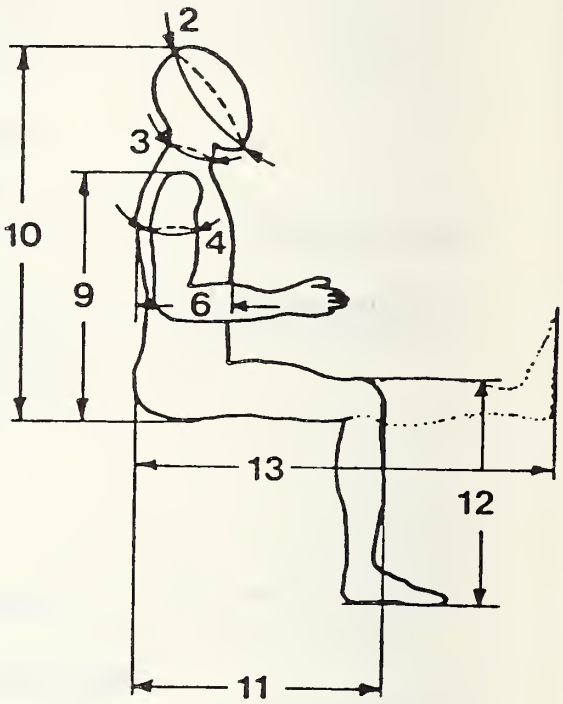
Run No. H 83 16

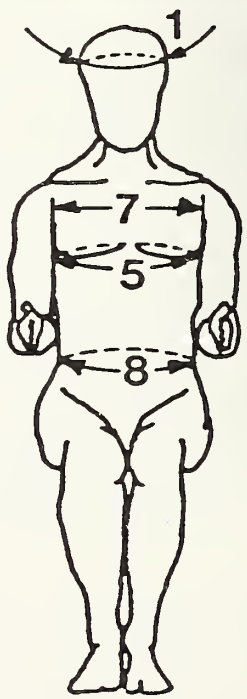
Anthropometrical Data

Body weight ..... 68 kg

Body length ..... 171 cm

1. Hat dimension ..... 55 cm
2. Head circumference ..... 66 cm
3. Neck circumfer. ..... 36 cm
4. Upper arm circumfer. ..... 29 cm
5. Chest circumfer. ..... 89 cm
6. Chest height ..... 22 cm
7. Chest width ..... 3o cm
8. Abdomen circumfer. ..... 77 cm
9. Buttocks - shoulder ..... 68 cm
10. Seat height ..... 92 cm
11. Pelvis - knee ..... 57 cm
12. Sole of foot - knee ..... 54 cm
13. Pelvis - heal ..... 1o1 cm





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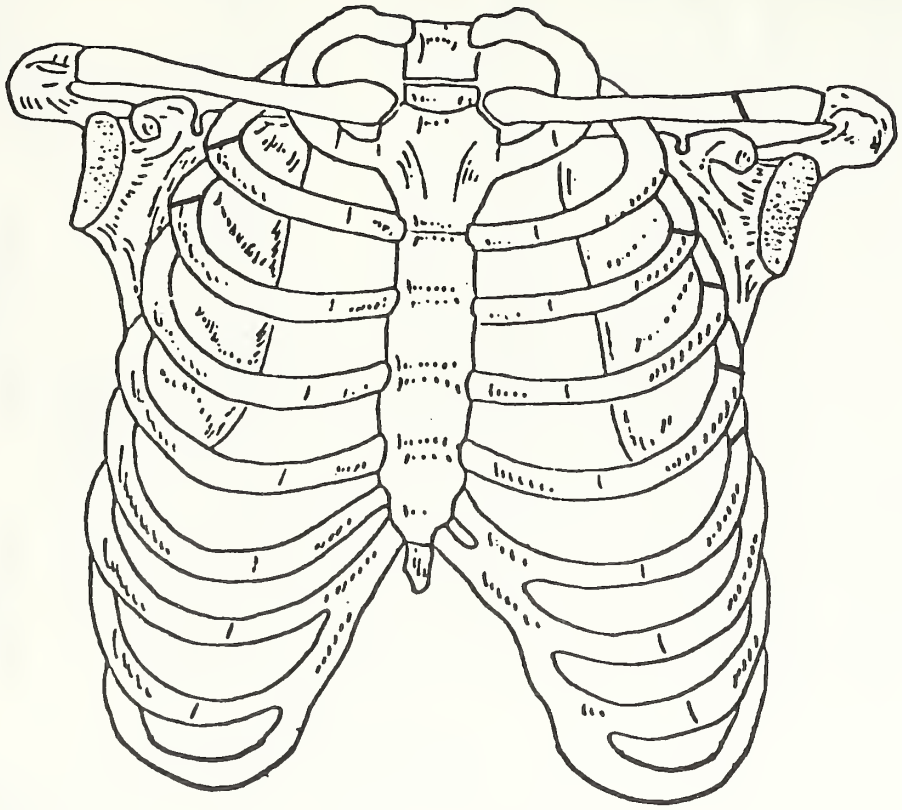
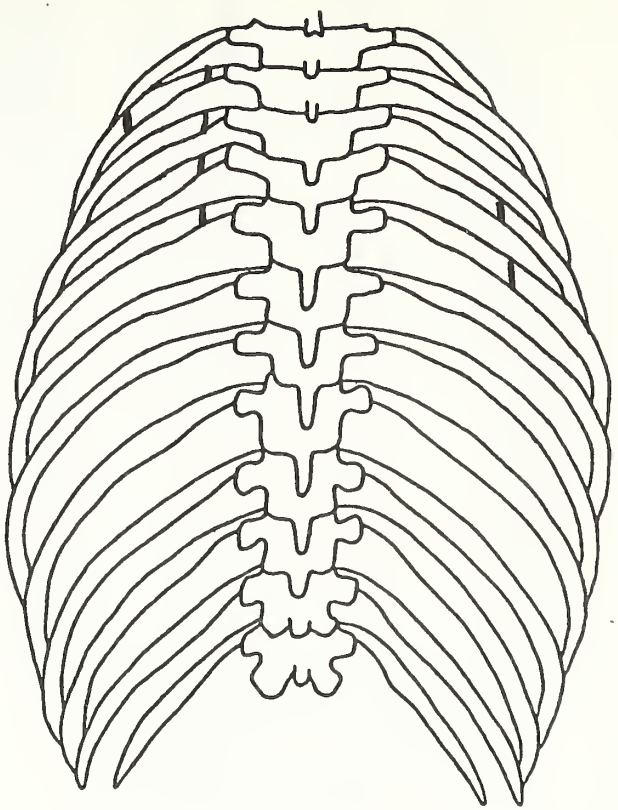
Run No. H 83 16 DOT





Number of rib fractures 13

Run No. H8321

a) Subject

Male, 38 years, body weight 58 kg, body length 165 cm (further anthropometric data s. incl.), cause of death: bronchopneumonia.

b) Test conditions

Lateral impact, Volvo door, impact velocity 36 km/h.

c) Instrumentation

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings

Body surface:	No injuries.
Head:	Fracture of the base of the skull left.
Thorax:	Fracture of the 3d-5th rib right in the middle axillar line, of the 6th rib in the front axillar line. Fracture of the 2d-9th rib left in the middle axillar line. Fracture of the 2d-10th rib left in the paravertebral region, of the 9th-11th rib in the middle scapular line (incl.).
Abdomen:	No injuries.
Pelvis:	10 cm long fracture of the wing of the ilium left with central fracture line ramification to the upper and lower area of the wing of the ilium.
Vertebral column:	No injuries
Extremities:	No injuries

e) AIS-Severity: Body surface 0, head 3, thorax 4, abdomen 0, pelvis 2, vertebral column 0, extremities 0, MAIS 4.

BENDING TESTS

Run No. H 8321	max. Force (N)	max. Deflex. (mm)	Cross Section (mm^2)
6th rib	96	3	32
7th rib	89	3	27

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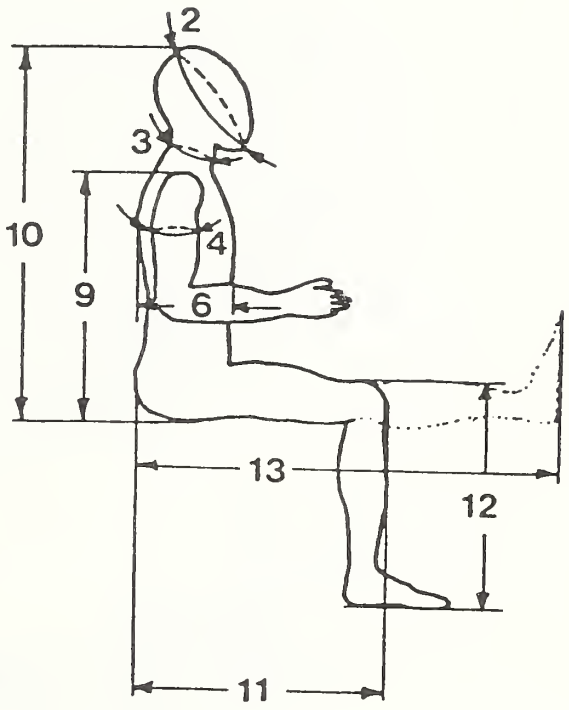
Run No. H 83 21

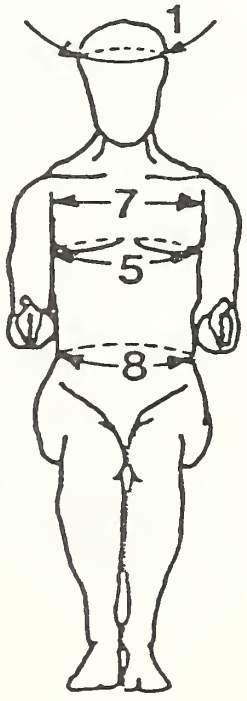
Anthropometrical Data

Body weight ..... 58 kg

Body length ..... 165 cm

1. Hat dimension .....53.....cm
2. Head circumference.....63.....cm
3. Neck circumfer. .....36.....cm
4. Upper arm circumfer. .....25.....cm
5. Chest circumfer. .....84.....cm
6. Chest height .....21.....cm
7. Chest width .....29.....cm
8. Abdomen circumfer. .....79.....cm
9. Buttocks - shoulder .....67.....cm
10. Seat height .....92.....cm
11. Pelvis - knee .....53.....cm
12. Sole of foot - knee .....49.....cm
13. Pelvis - heal .....91.....cm





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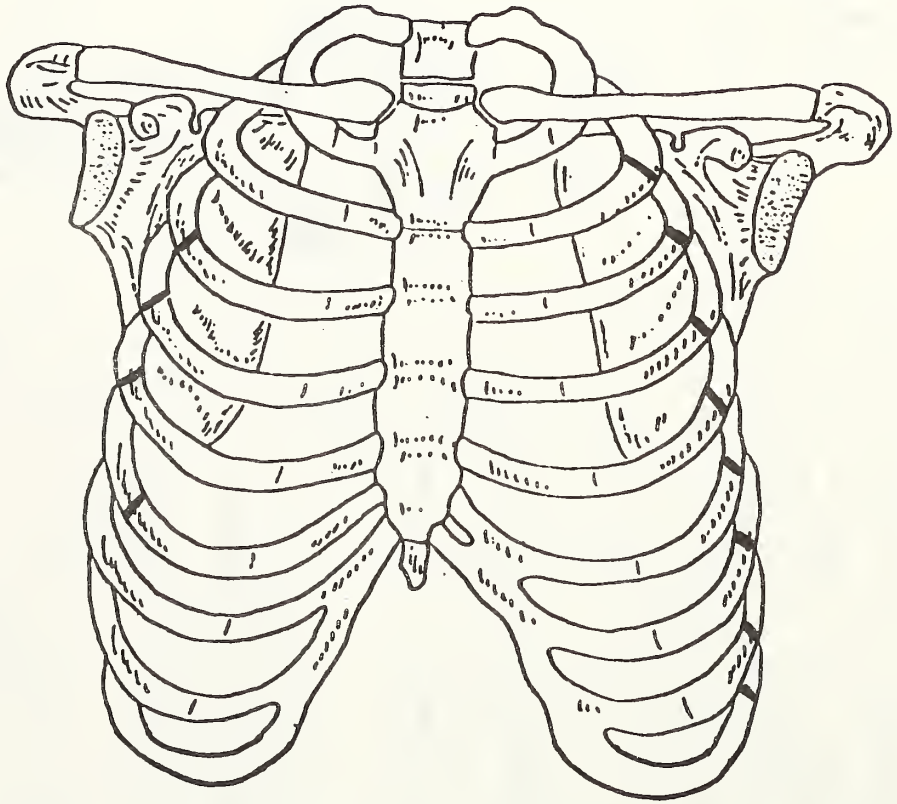
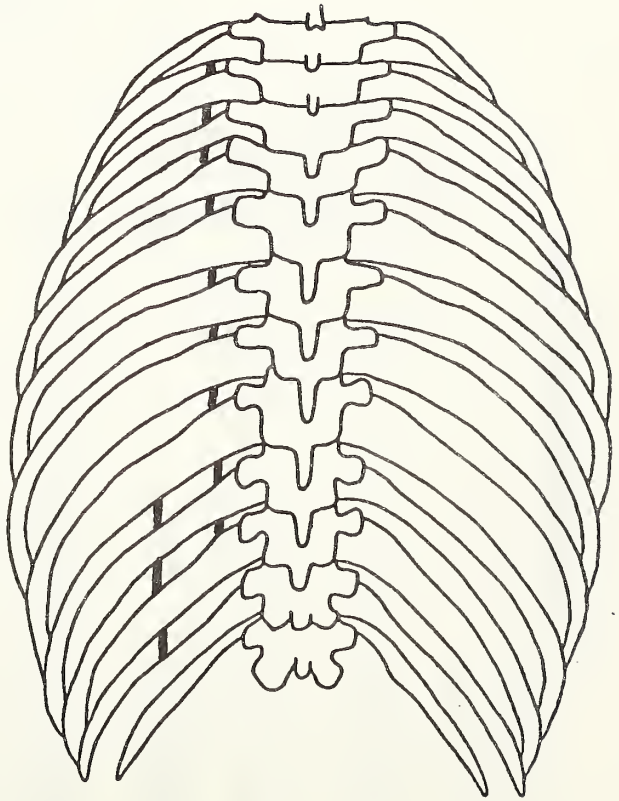
Run No. H 83 21 DOT





Number of rib fractures 24

Run No. H 8330

a) Subject:
Male, 42 years, body weight 86 kg, body lenght 187 cm (further anthropometrical data s. incl.), cause of death: acute poisoning.

b) Test conditions:
Lateral impact, Volvo door, impact velocity 18 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:
No injuries.

e) AIS-Severity: 0

BENDING TESTS

Run No. H 8330

	max. Force (N)	max. Defl. (mm)	Cross Section (mm^2)
6th rib	213	3,4	32
7th rib	333	4,0	40

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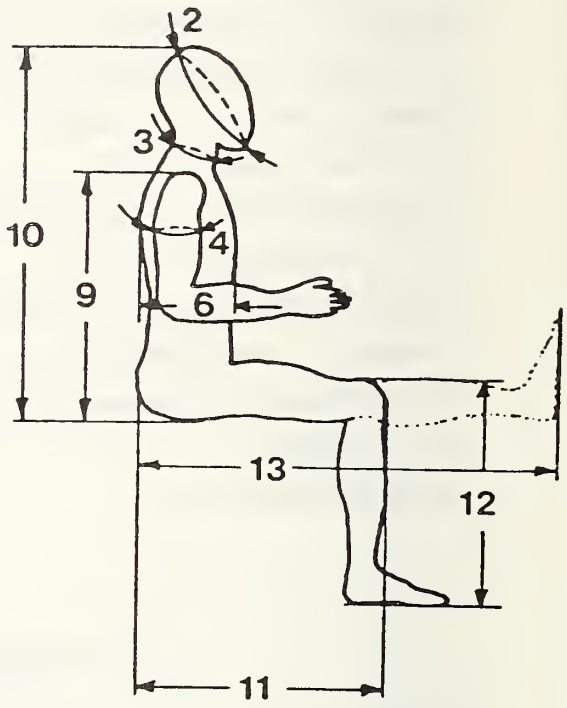
Run No. H 83 3o

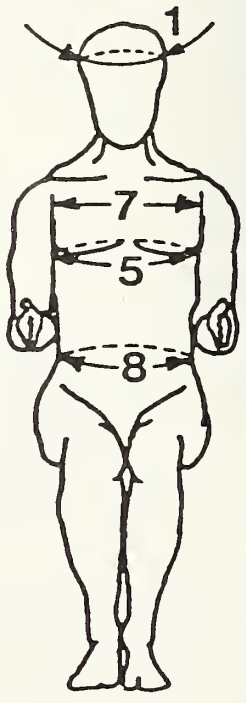
Anthropometrical Data

Body weight ....86. kg

Body length ....187. cm

1. Hat dimension .....56.....cm
2. Head circumference.....68.....cm
3. Neck circumfer. .....37.....cm
4. Upper arm circumfer. .....25.....cm
5. Chest circumfer. .....97.....cm
6. Chest height .....24.....cm
7. Chest width .....34.....cm
8. Abdomen circumfer. .....89.....cm
9. Buttocks - shoulder .....74.....cm
10. Seat height .....98.....cm
11. Pelvis - knee .....65.....cm
12. Sole of foot - knee .....58.....cm
13. Pelvis - heal .....108.....cm





Run No. H 8331

a) Subject:

Male, 43 years, body weight 62 kg, body length 170 cm (further anthropometrical data s. incl), cause of death: acute poisoning.

b) Test conditions:

Lateral impact, Volvo door, impact velocity 27 km/h.

c) Instrumentation:

Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure.

d) Medical findings:

Body Surface:	Abrasion over the left crest of the ilium.
Head:	Contusion in the scalp over the parietal bone.
Thorax:	Fracture of the 2nd to 6th rib left in the paravertebral region; fracture of the 2nd to 9th rib left in the axillar line (incl.).
Abdomen:	No injuries.
Pelvis:	No injuries.
Vertebral Column:	Strain in the interspinal space between C1 and C2 left (NLTJ1).
Extremities:	Abrasion over the left elbow and the left lateral malleolus.
e) AIS-Severity:	Body Surface 1, Head 1, Thorax 3, Abdomen 0, Pelvis 0, Vertebral Column 1, Extremities 1, MAIS 3.

BENDING TESTS

Run No. H 8331	max. Force (N)	max. Defl. (mm)	Cross Section (mm^2)
6th rib	115	3,2	22
7th rib	131	2,5	22

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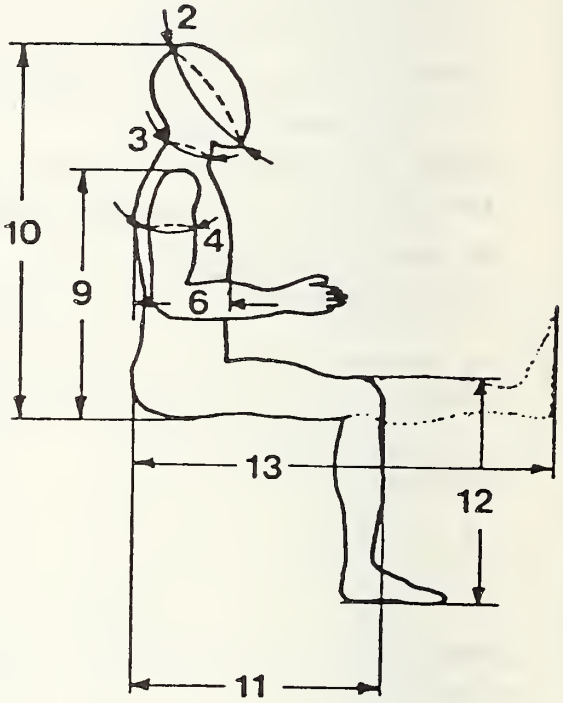
Run No. H 83 31 .....

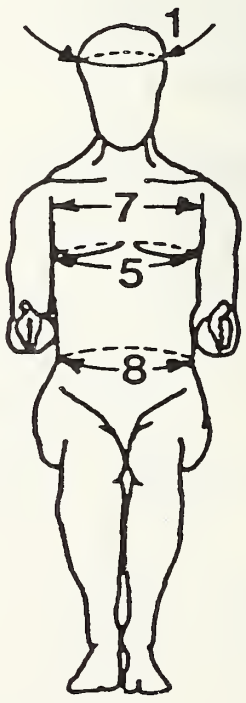
Anthropometrical Data

Body weight ....62 kg

Body length ....170 cm

1. Hat dimension .....54.....cm
2. Head circumference.....65.....cm
3. Neck circumfer. .....35.....cm
4. Upper arm circumfer. .....25.....cm
5. Chest circumfer. .....87.....cm
6. Chest height .....24.....cm
7. Chest width .....30.....cm
8. Abdomen circumfer. .....77.....cm
9. Buttocks - shoulder .....68.....cm
10. Seat height .....90.....cm
11. Pelvis - knee .....58.....cm
12. Sole of foot - knee .....53.....cm
13. Pelvis - heal .....97.....cm





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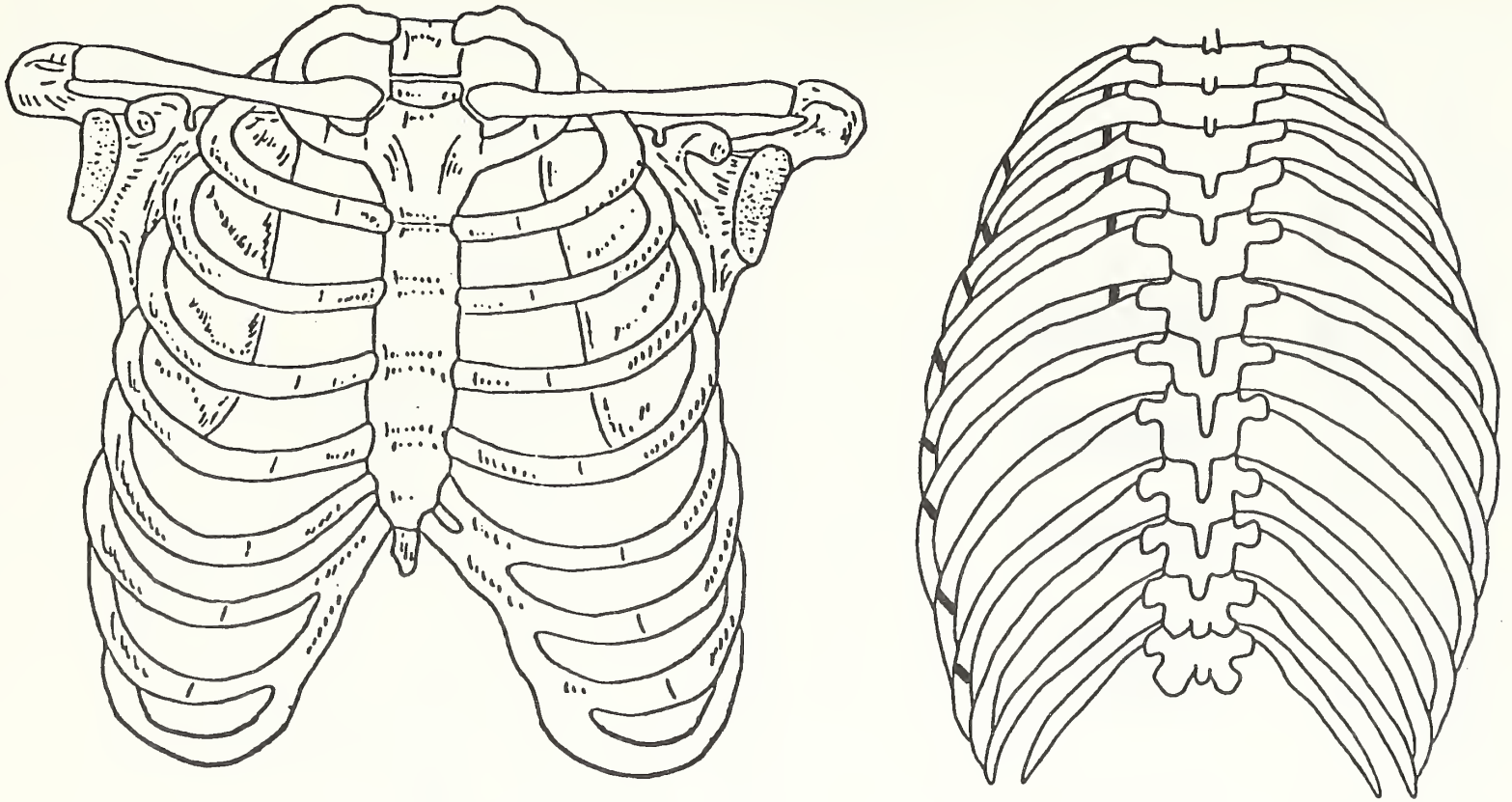
Run No. H 83 31 DOT



Number of rib fractures ..13..

APPENDIX VII

FRONTAL IMPACT
THREE POINT BELT
CADAVER TESTS
IMPACT VELOCITY :
50 KM/H

ANTROPOMETRICAL DATA

Run No	Sex	AGE Years	Body Weight kg	Body Lenght cm	Hat size cm	occip.-chin cir cm	Neck circumf cm	Upper arm cir cm	Chest circumf. cm
H 8001	male	38	70	171	56	64	39	30	91
H 8002	female	32	61	172	52	62	31	22	82
H 8005	male	25	80	200	57	68	38	29	95
H 8006	female	34	48	157	54	64	32	24	80
H 8008	male	19	66	180	56	66	36	28	87
5	M 3 F 2	29.6	65	176	55	64.8	35.2	26.6	87

CONTINUE ANTROPOMETRICAL DATA

Run No	Chest height cm	Chest width cm	Abdom circumf cm	Buttocks shoulder cm	Seat height cm	Pelvis knee cm	Sole of foot knee cm	Pelvis heal cm
H 8001	22	32	80	66	91	55	49	96
H 8002	18	27	68	72	100	54	48	94
H 8005	23	33	79	80	106	66	62	113
H 8006	17	28	63	64	87	51	44	87
H 8008	22	30	69	68	93	58	55	100
5	20.4	30	71.8	70	95.4	56.8	51.6	98

RIB. FRACT.

Run No	Impact Area Specific.	Collis. Veloc. km/h	Number Rib. Fract.	Number Rib.Fr Left s	Left side Front	Left side Rear	Number Rib.Fr Right	Right side Front	Right side Rear
H 8001	-----	50	5	0	0	0	5	5	0
H 8002	-----	50	3	1	1	0	2	2	0
H 8005	-----	49	5	5	5	0	0	0	0
H 8006	-----	51	4	1	1	0	3	3	0
H 8008	-----	49	2	2	2	0	0	0	0
5	-----	49.8	3.8	1.8	1.8	0	2	2	0

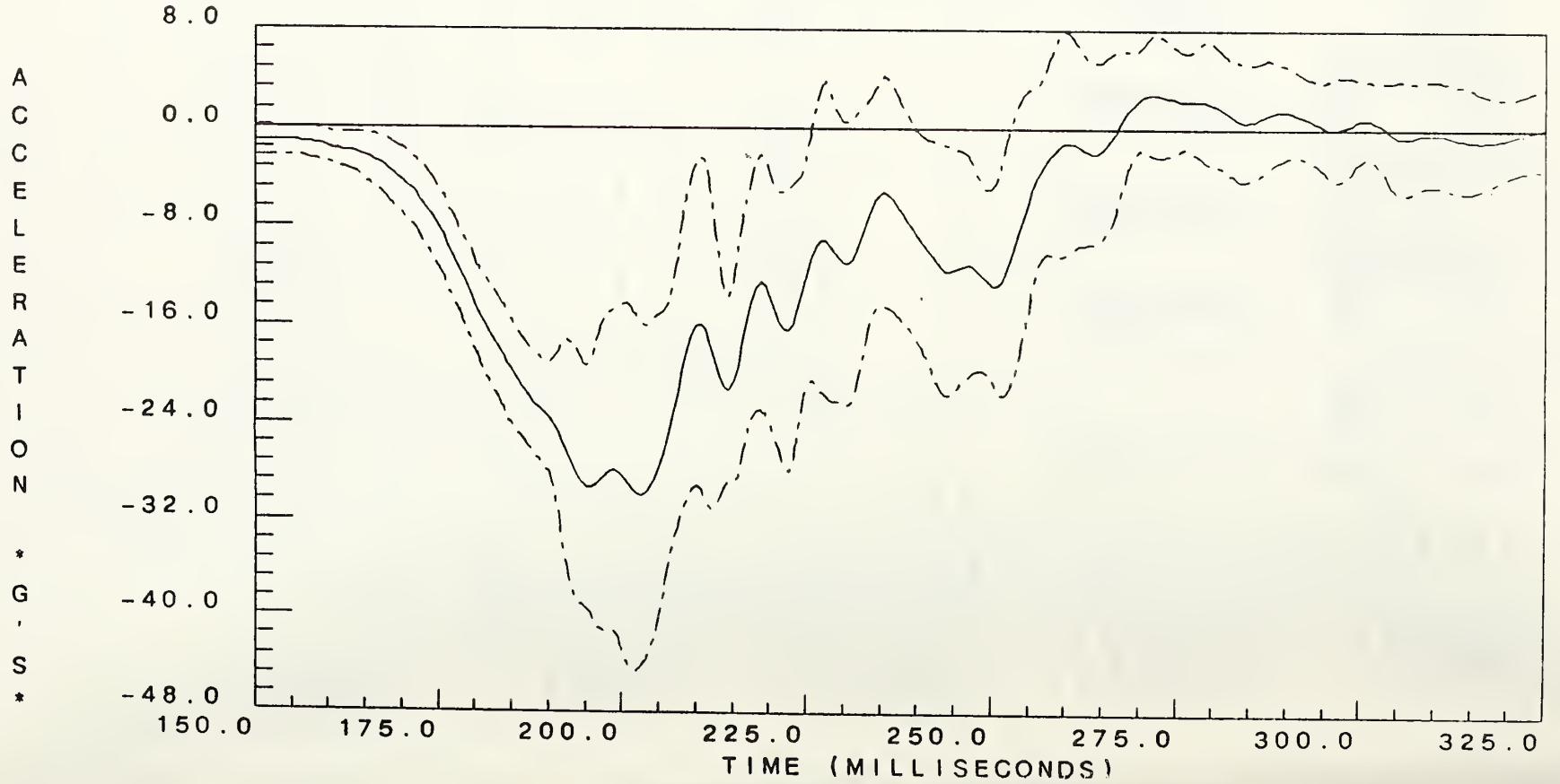
AIS - SEVERITY

Run No	Body Surface	Head	Thorax	Abdomen	Pelvis	Spine	Extrem.	MAIS
H 8001	0	0	3	1	0	2	0	3
H 8002	0	0	3	1	0	3	0	3
H 8005	0	0	3	0	0	0	0	3
H 8006	0	0	3	0	0	3	0	3
H 8008	0	0	3	1	0	2	0	3
5	0	0	3	.6	0	2	0	3

Run No	6th RIB max. Force [N]	6th RIB max. Defl. [mm]	6th RIB Cross section [mm2]	7th RIB max. Force [N]	7th RIB max. Defl. [mm]	7th RIB Cross section [mm2]
H 8001	395	4.0	45.7	316	5.0	38.4
H 8002	235	-	32.4	236	6.0	32.3
H 8005	291	5.0	26.5	346	5.0	29.2
H 8006	178	6.6	26.6	200	6.2	31.7
H 8008	213	5.7	30.6	206	5.8	33.0
5	282.4	5.33	32.4	261.2	5.6	33.52

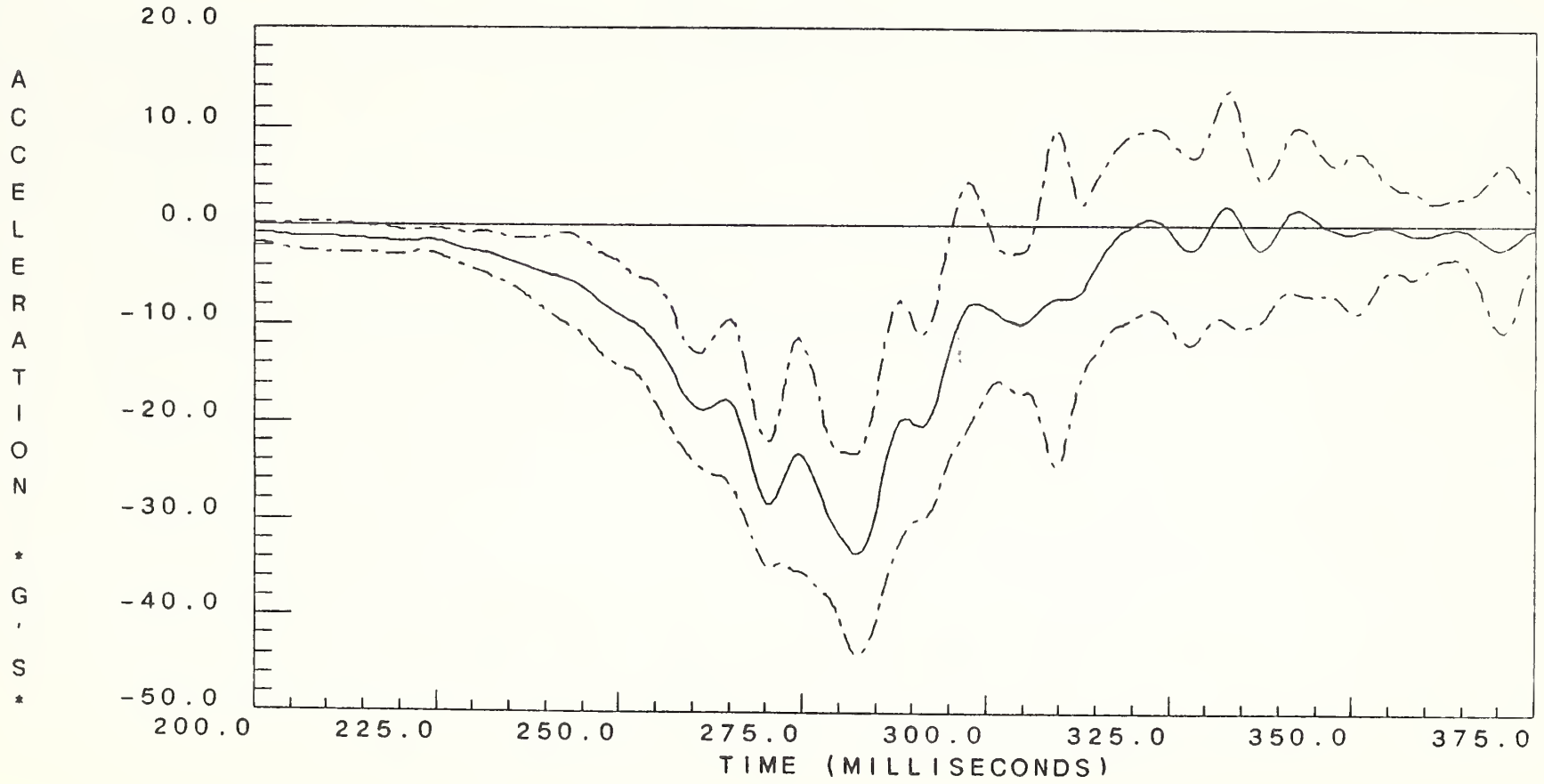
Mean Response with +/- 1 St. Dev. Corridor

Frontal 30 MPH Belted, Upper Sternum (X)



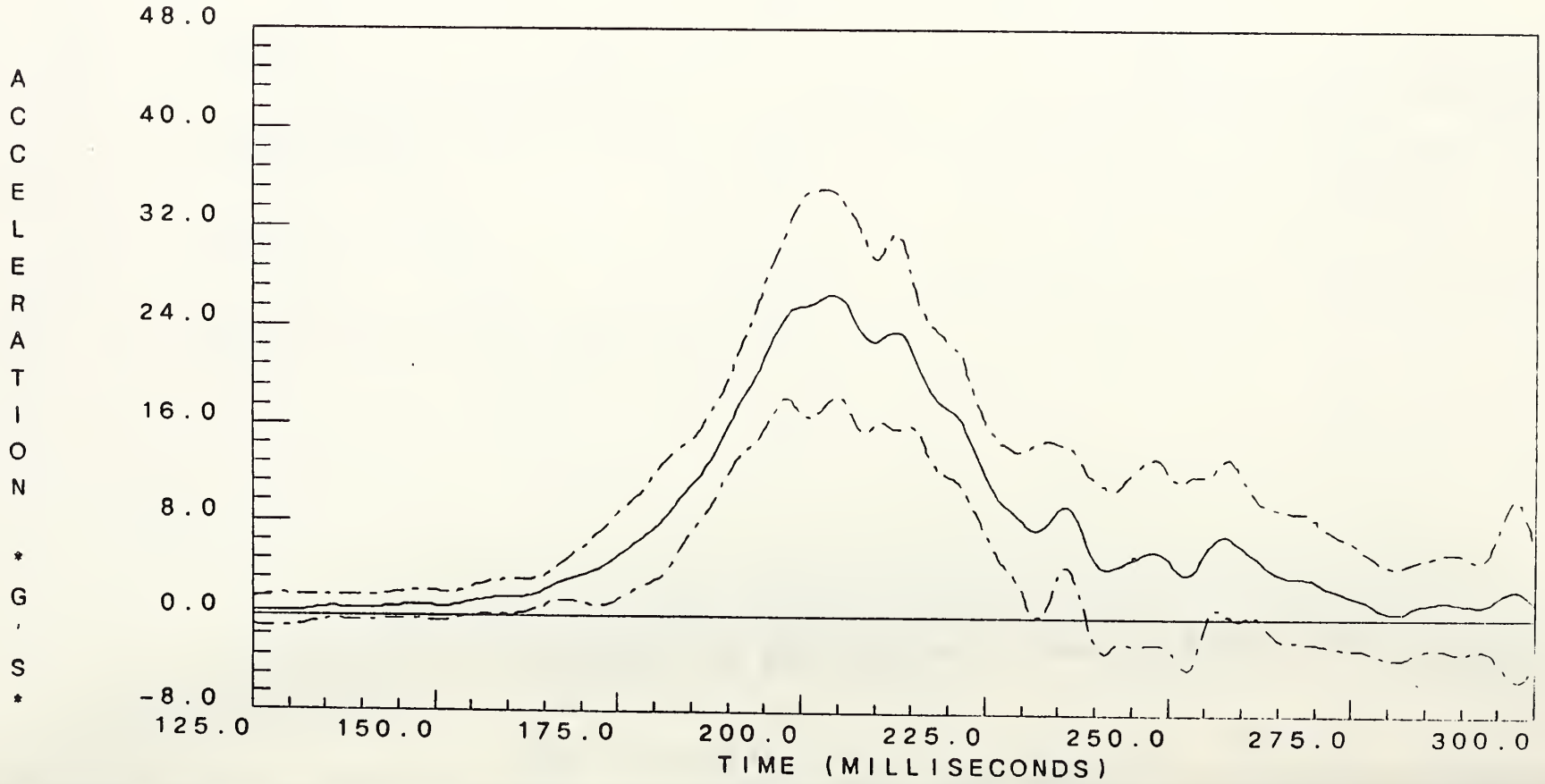
Mean Response with +/- 1 St. Dev. Corridor

Frontal 30 MPH Belted, Lower Sternum (X)



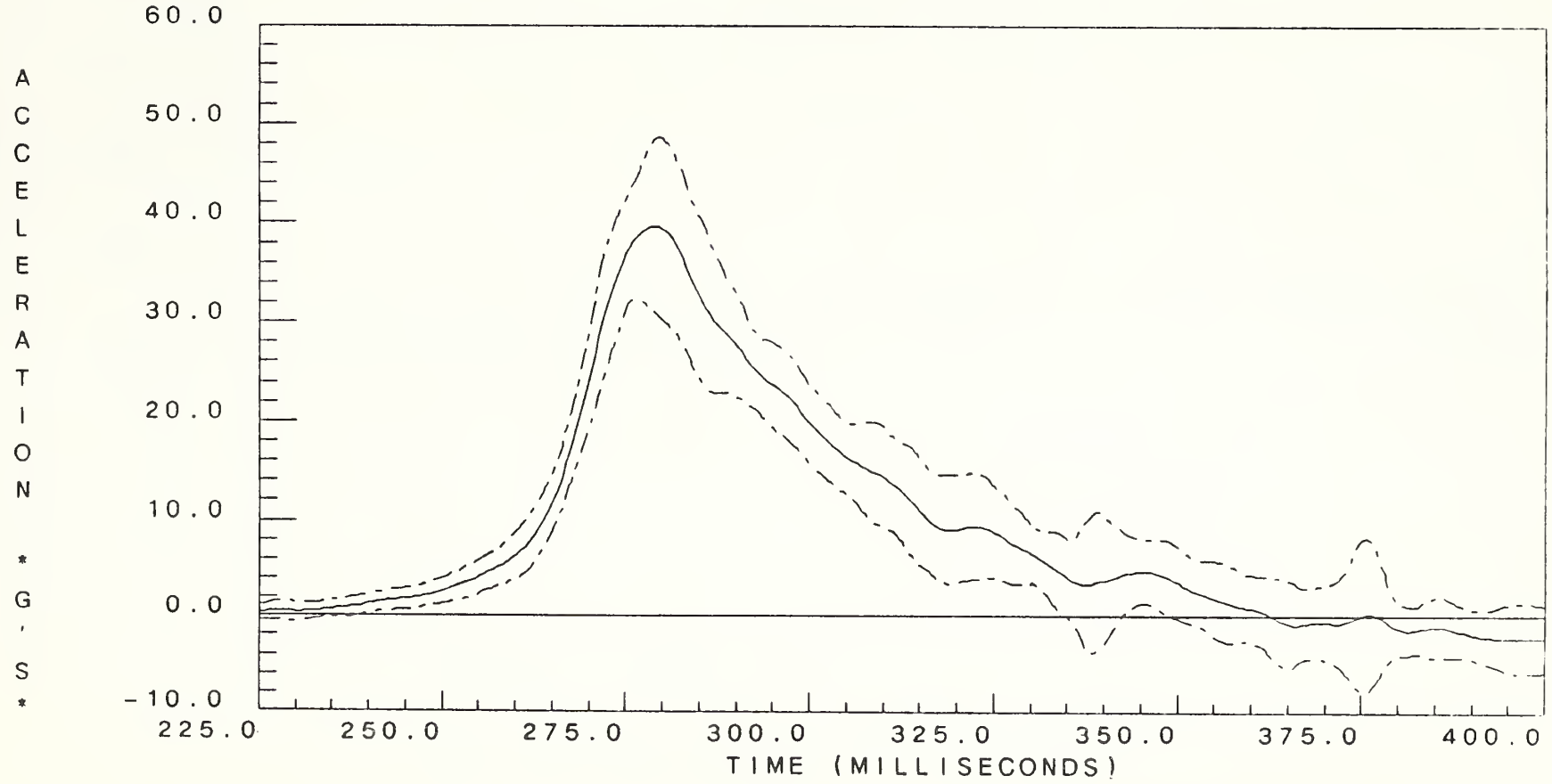
Mean Response with +/- 1 St. Dev. Corridor

Frontal 30 MPH Belted, Upper Spine (X)



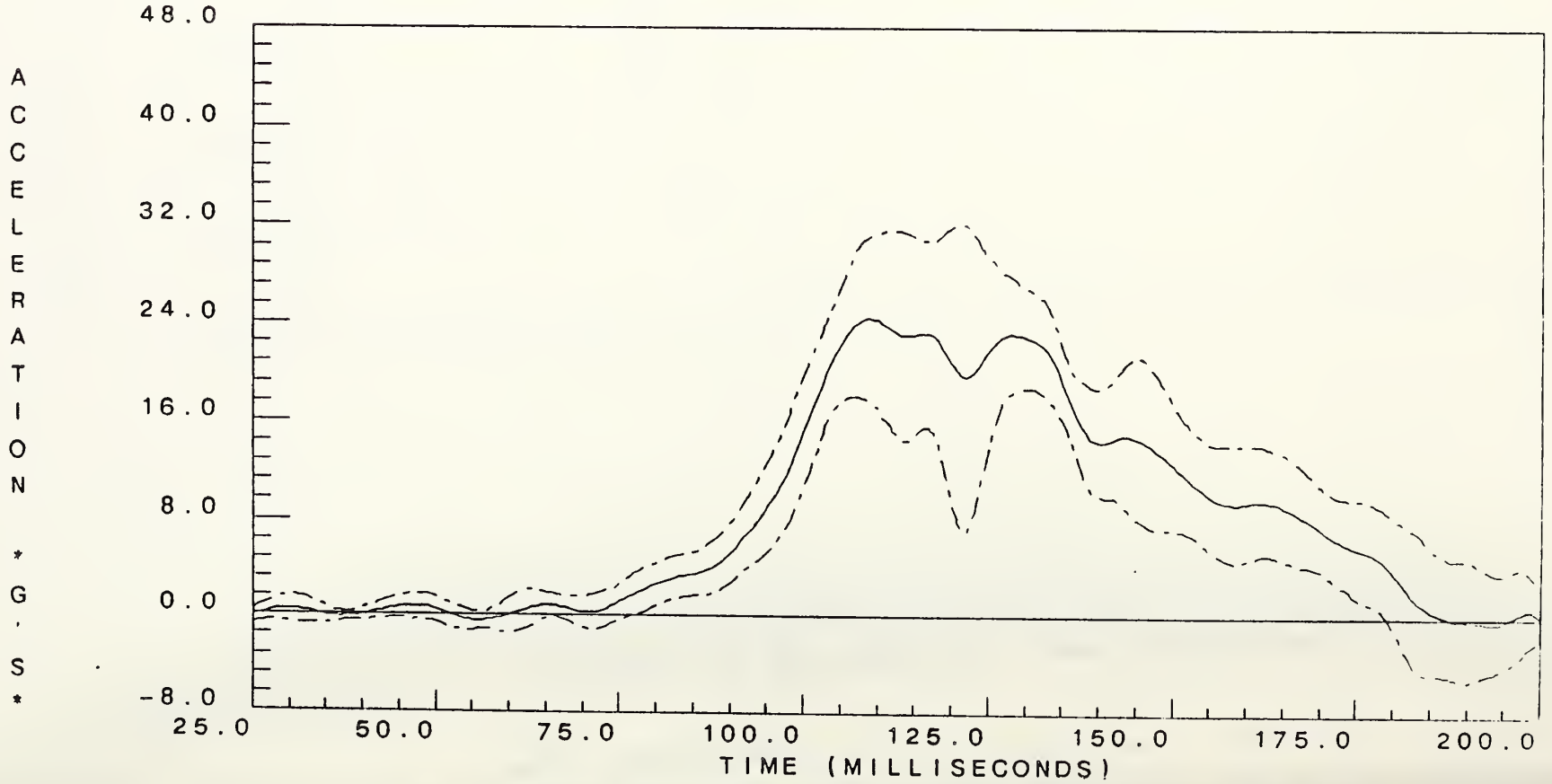
Mean Response with +/- 1 St. Dev. Corridor

Frontal 30 MPH Belted, Lower Spine (X)



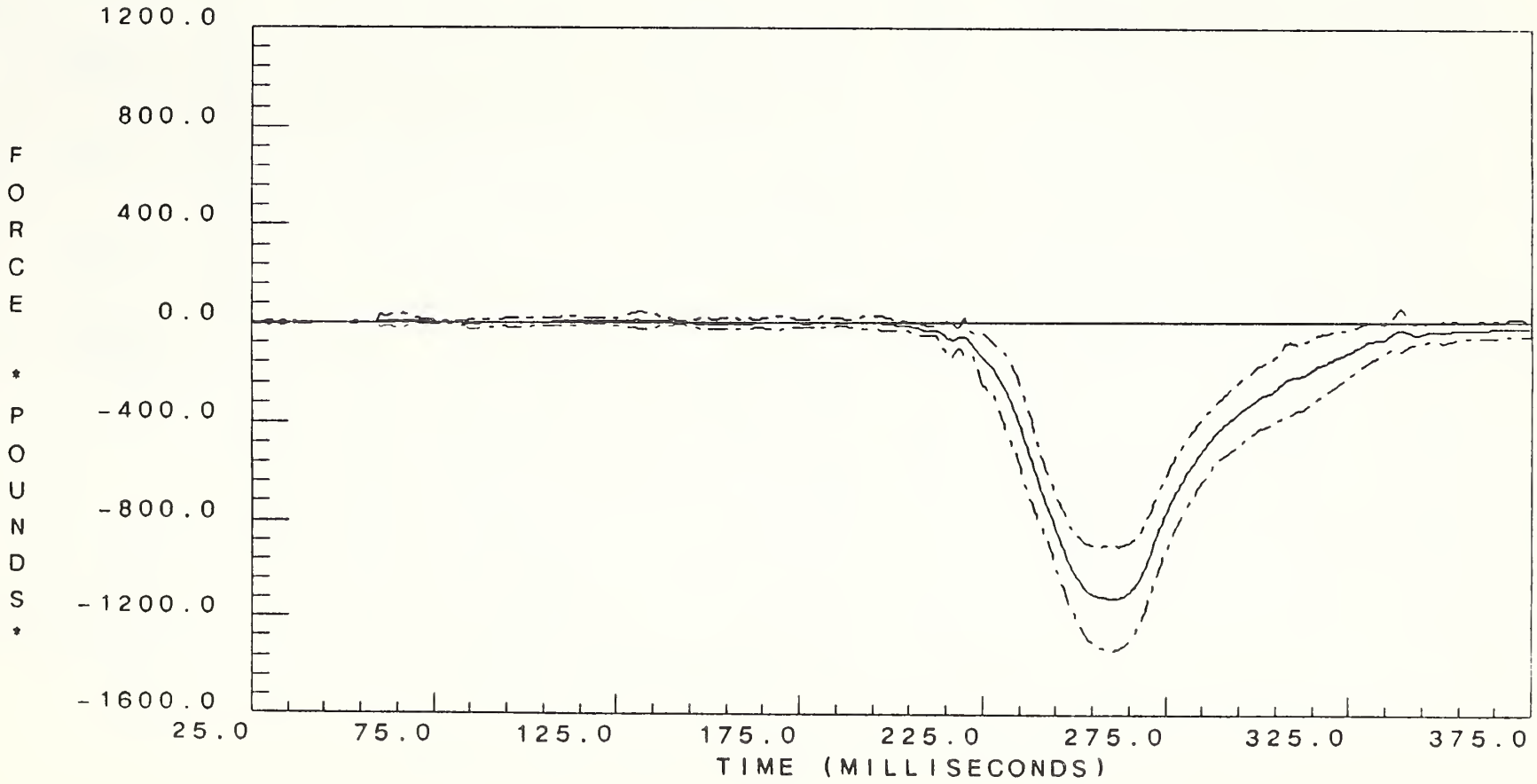
Mean Response with +/- 1 St. Dev. Corridor

Frontal 30 MPH Belted, Center Pelvis (X)



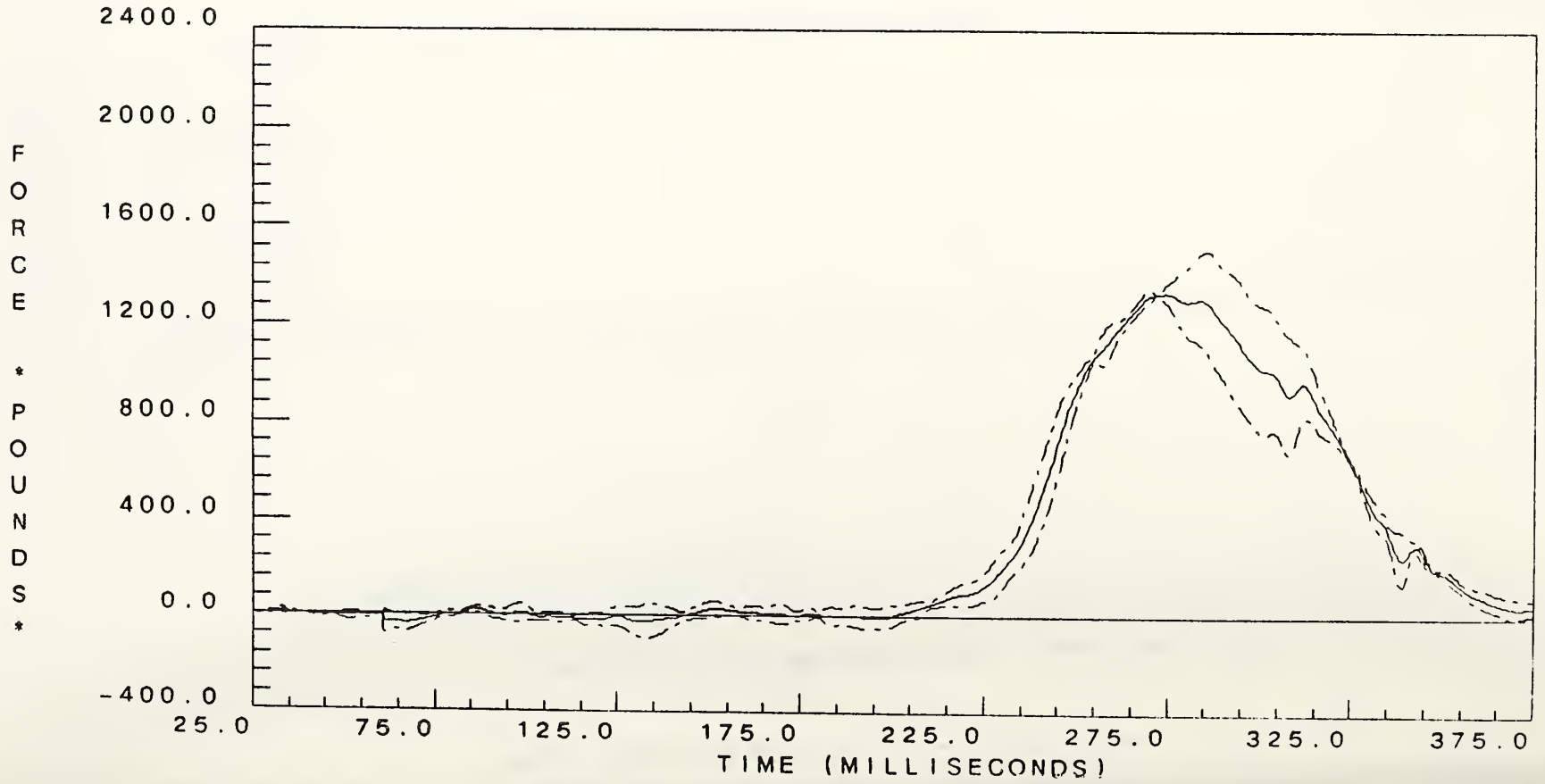
Mean Response with +/- 1 St. Dev. Corridor

Frontal 30 MPH Belted, Lap Belt (X)



Mean Response with +/- 1 St. Dev. Corridor

Front 30 MPH Belted, Shoulder Belt (X)



Run No. H 8001

a) Subject: Male, 38 years, body weight: 70 kg, body length: 171 cm, (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions: Frontal collision, impact velocity: 50 km/h, Volvo-Puls, medium sled deceleration: 16 g (evaluated from the collision velocity and the stopping distance).

c) Instrumentation: Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, lap-belt force.

Medical Findings:

Body Surface: Skin abrasion over the left shoulder and the hip bones.

Thorax: Hemorrhages of the scaline muscles left. Fracture of the manubrium sterni. Double fracture of the 2nd rib right in the cartilage area and in the front axillar line. Fracture of the 3rd, 4th and 5th rib right in the cartilage-bone transition.

Abdomen: No injuries.

Vertebral Column: Lacerations of the ligamentum flavum between C3/C4, C7/Th1. The vertebral body Th2 showed an anterior margin fracture. Muscle hemorrhages between occiput and C1/C2. Fracture of the occipital condyle right.

AIS Severity: Body surface 1, Thorax 3 , Abdomen 1, Vertebral Column 2, MAIS 3 .

BENDING TESTS

Run No.H80001

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	395	4,0	46
7th rib	318	5,0	36

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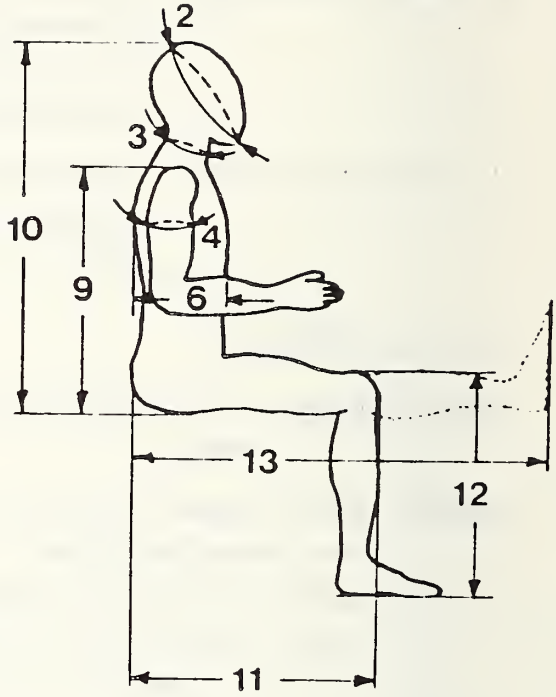
Run No. H 80.01..

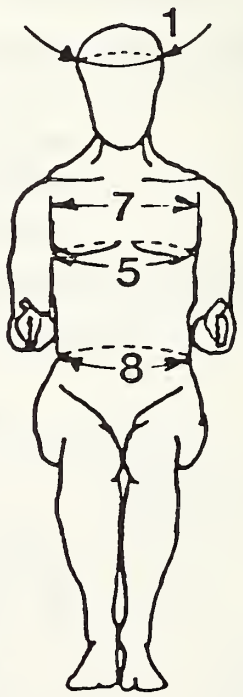
Anthropometrical Data

Body weight ....70. kg

Body length ....171. cm

1. Hat dimension .....56.....cm
2. Head circumference.....64.....cm
3. Neck circumfer. .....39.....cm
4. Upper arm circumfer. .....30.....cm
5. Chest circumfer. .....91.....cm
6. Chest height .....22.....cm
7. Chest width .....32.....cm
8. Abdomen circumfer. .....80.....cm
9. Buttocks - shoulder .....66.....cm
10. Seat height .....91.....cm
11. Pelvis - knee .....55.....cm
12. Sole of foot - knee .....49.....cm
13. Pelvis - heal .....96.....cm





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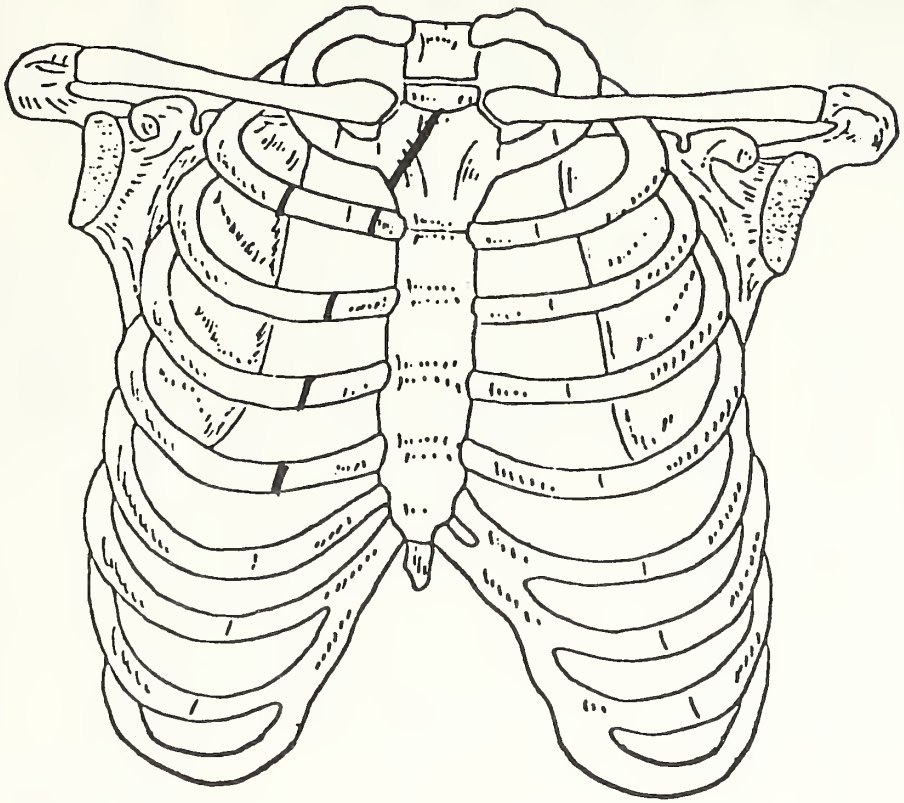
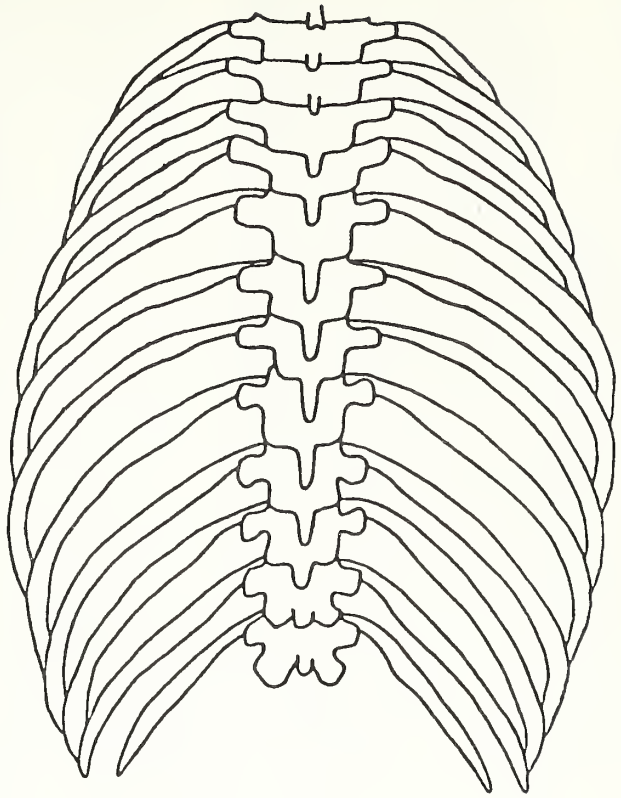
Run No. H 80 01 DOT





Number of rib fractures 5

Run No. H 8002

a) Subject: Female, 32 years, body weight: 61 kg, body length: 172 cm, (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions: Frontal collision, impact velocity: 50 km/h, Volvo-Puls, medium sled deceleration: 16 g (evaluated from the collision velocity and the stopping distance).

c) Instrumentation: Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, lap-belt force.

Medical Findings:

Body Surface: Skin abrasion over the left shoulder and the hip bones.

Thorax: Fracture of the left clavicle. Fracture of the sternum from 3rd rib left to 4th rib right. Fracture of the 4th rib left in the front axillar line. Fracture of the 7th and 8th rib right in the front axillar line.

Abdomen: No injuries.

Vertebral Column: Hemorrhages into the medium and deep muscle layers right at C1, C2. Further, at the right side over Th1 and Th2 a stronger bleeding of the medium and deep muscle layers. At the left side a small hemorrhage into the deep muscle layers over Th1 and Th2. Lacerations of the ligamentum flavum between C6/C7 and C7/Th1; hemorrhages in the corresponding interspinal spaces. Hemorrhages of the interspinal space between C1 and C2. Fracture of the transversus processus C2, left and right. Articular capsule lacerations at C2/C3 left.

AIS Severity: Body surface 1, Thorax 3 , Abdomen 0, Vertebral Column 3, MAIS 3.

Run No.H80002

BENDING TESTS

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	235	-	32
7th rib	236	6,0	32

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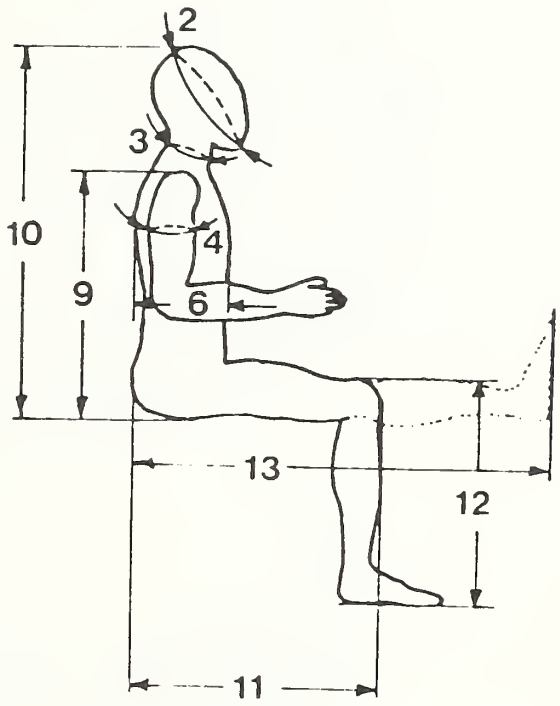
Run No. H 80 02

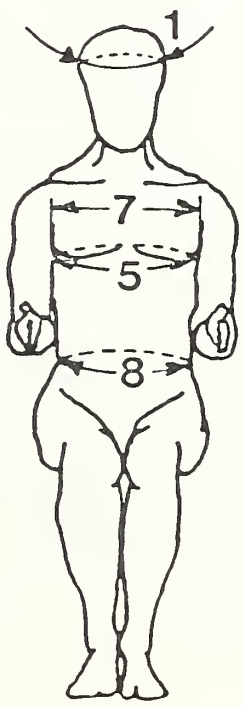
Anthropometrical Data

Body weight ....61.... kg

Body length ....172.... cm

1. Hat dimension .....52.....cm
2. Head circumference.....62.....cm
3. Neck circumfer. .....31.....cm
4. Upper arm circumfer. .....22.....cm
5. Chest circumfer. .....82.....cm
6. Chest height .....18.....cm
7. Chest width .....27.....cm
8. Abdomen circumfer. .....68.....cm
9. Buttocks - shoulder .....72.....cm
10. Seat height .....100.....cm
11. Pelvis - knee .....54.....cm
12. Sole of foot - knee .....48.....cm
13. Pelvis - heal .....94.....cm





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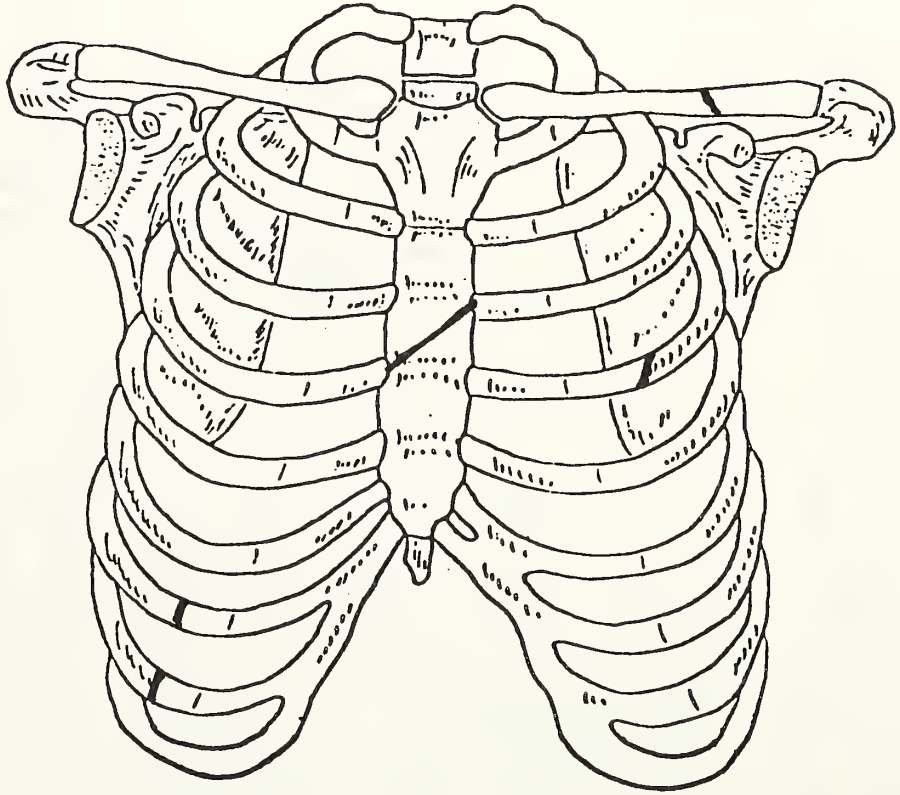
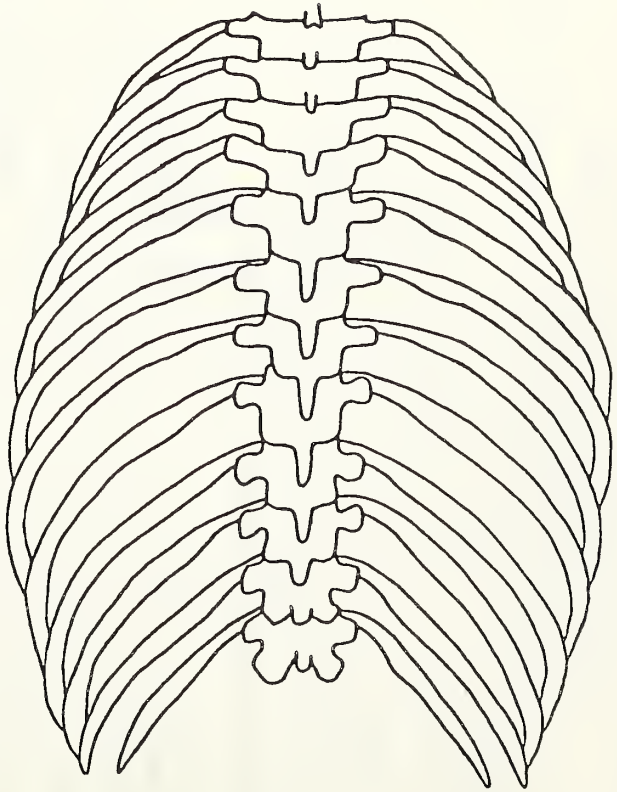
Run No. H 80 02 DOT





Number of rib fractures 3

Run No. H 80 005

a) Subject:
Male, 25 years, body weight 80 kg, body length 200 cm (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Testconditions:
Frontal collision, impact velocity 49,2 km/h, Volvo-Puls, medium sled deceleration 13,8 g (evaluated from the collision velocity and the stopping distance).

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, lap-belt force.

d) Medical findings:

Body surface:	No injuries
Head:	No injuries
Thorax:	Fracture of the xiphoid process. Fractures of the 4th to 7th rib left, directly to the sternum, 2nd fracture of the 7th rib 5 cm left to the sternum centerline (incl.
Abdomen:	No injuries
Vertebral Column:	No injuries
Extremities:	No injuries

e) Severity degree:
AIS-Thorax 3, AIS-Abdomen 0, AIS-Vertebral Column 0, MAIS - 3

BENDING TESTS

Run No.H80005

	max. Force (N)	max.Deflexion (mm)	Cross Section (mm^2)
6th rib	291	5,0	27
7th rib	346	5,0	29

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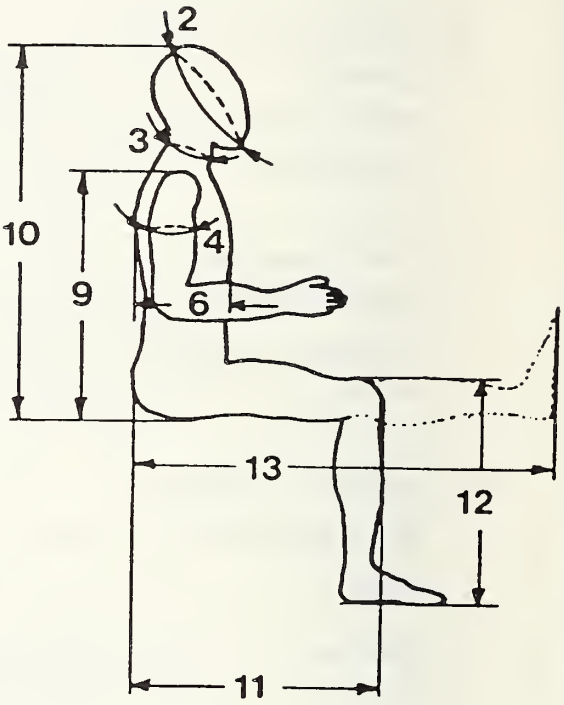
Run No. H 80 005

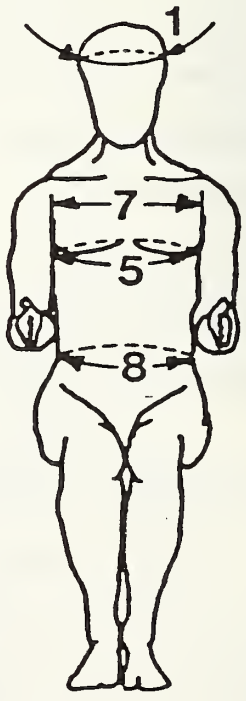
Anthropometrical Data

Body weight ....80 kg

Body length ....200 cm

1. Hat dimension .....57.....cm
2. Head circumference.....68.....cm
3. Neck circumfer. .....38.....cm
4. Upper arm circumfer. .....29.....cm
5. Chest circumfer. .....95.....cm
6. Chest height .....23.....cm
7. Chest width .....33.....cm
8. Abdomen circumfer. .....79.....cm
9. Buttocks - shoulder .....80.....cm
10. Seat height .....106.....cm
11. Pelvis - knee .....66.....cm
12. Sole of foot - knee .....62.....cm
13. Pelvis - heal .....113.....cm





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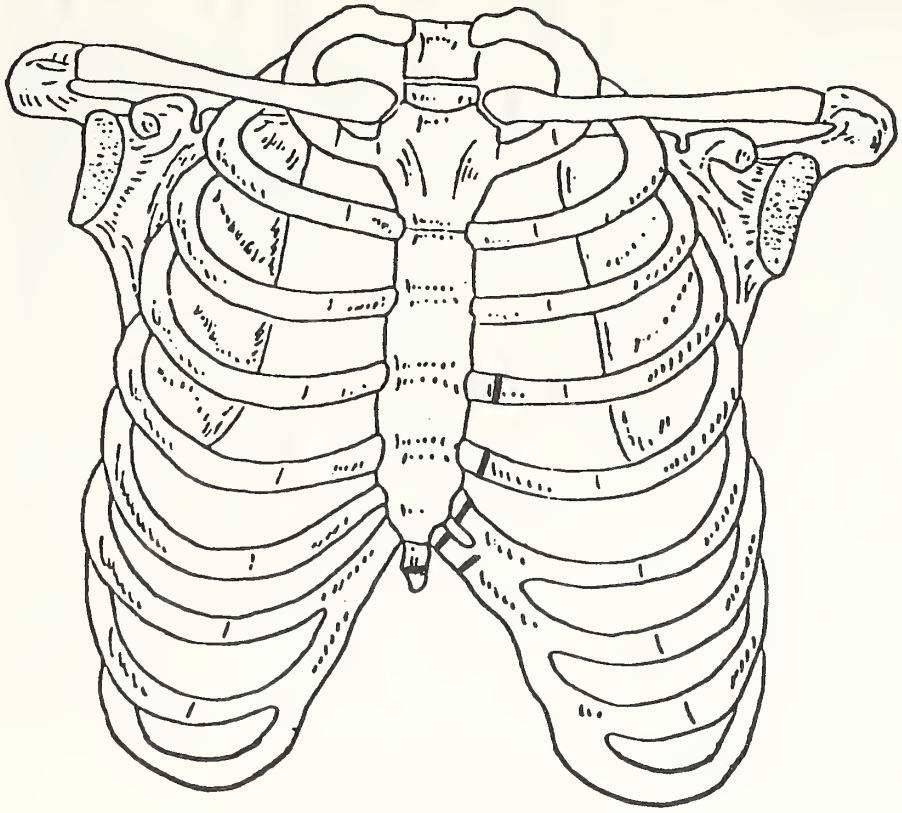

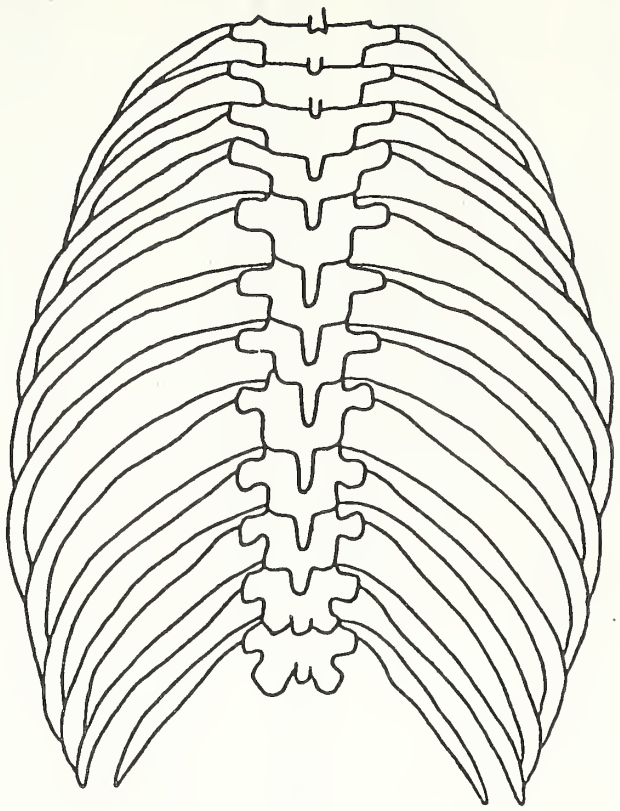

Number of rib fractures ..5...

Run No. H 80 006

a) Subject: Female, 34 years, body weight: 48 kg, body length: 157 cm, (further anthropometric data s. incl.), cause of death: poisoning acute.

b) Test conditions: Frontal collision, impact velocity 50,9 km/h, Volvo-Puls, medium sled deceleration 15 g (evaluated from the collision velocity and the stopping distance).

c) Instrumentation: Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, lung pressure, lap-belt force.

Medical Findings:

Body Surface: Skin abrasion over the left shoulder.

Thorax: Hemorrhage in the left anterior triangle of the neck and the left shoulder, sternum fracture in the level of the 3rd rib. Fracture of the 2nd rib left in the front axillar line, fracture of the 5th, 6th rib right in the cartilage-bone transition, fracture of the 7th rib right in the front axillar line.

Abdomen: No injuries.

Vertebral Column: Hemorrhages in the medium muscle layer right and left in the height of the 3rd lumbar vertebral body. Hemorrhage into the dorsal epidural space of C5 to Th12. Anterior margin fracture of the vertebral body Th3. The intervertebral disc Th2/Th3 is teared up in connection with the upper surface of the vertebral body fracture with strong hemorrhages.
In the same segment the ligamentum flavum and the interspinal ligamentous system is teared up. Ligamentum flavum laceration at C5/C6. At the right side cut, hemorrhages into the foramina intervertebralia at C2/C3, C4/C5, C5/C6 and C6/C7. At the left side cut, hemorrhages into the foramina intervertebralia of C4 to Th1/Th2.

AIS Severity: Body Surface 1, Thorax 3 , Abdomen 0, Vertebral Column 3, MAIS 3.

BENDING TESTS

Run No.H80006

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	178	7,0	27
7th rib	200	6,0	32

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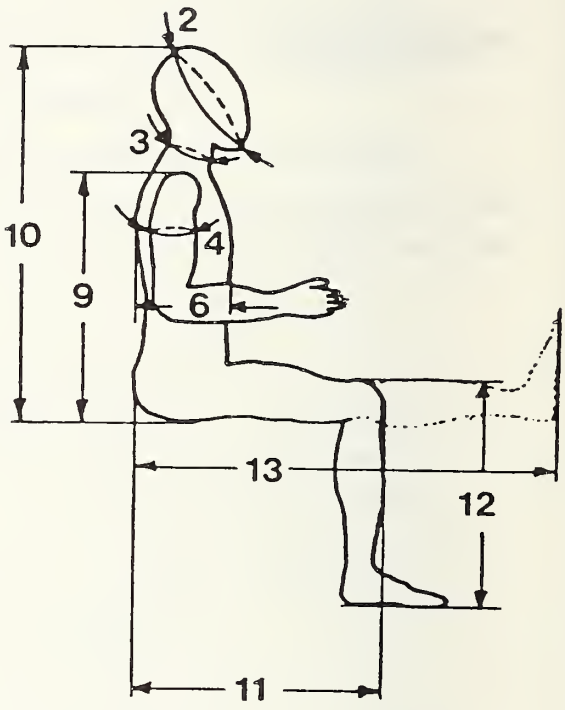
Run No. H 80 006

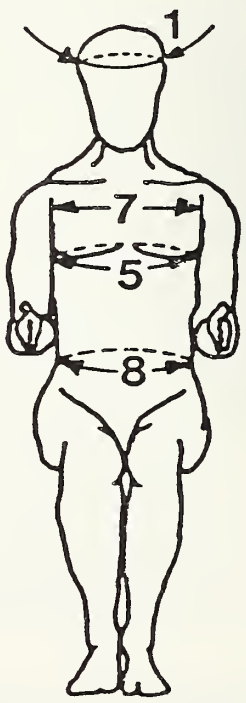
Anthropometrical Data

Body weight ..... 48 kg

Body length ..... 157 cm

1. Hat dimension ..... 54 ..cm
2. Head circumference..... 64 ..cm
3. Neck circumfer. ..... 32 ..cm
4. Upper arm circumfer. ..... 24 ..cm
5. Chest circumfer. ..... 8o ..cm
6. Chest height ..... 17 ..cm
7. Chest width ..... 28 ..cm
8. Abdomen circumfer. ..... 63 ..cm
9. Buttocks - shoulder ..... 64 ..cm
10. Seat height ..... 87 ..cm
11. Pelvis - knee ..... 51 ..cm
12. Sole of foot - knee ..... 44 ..cm
13. Pelvis - heal ..... 87 ..cm





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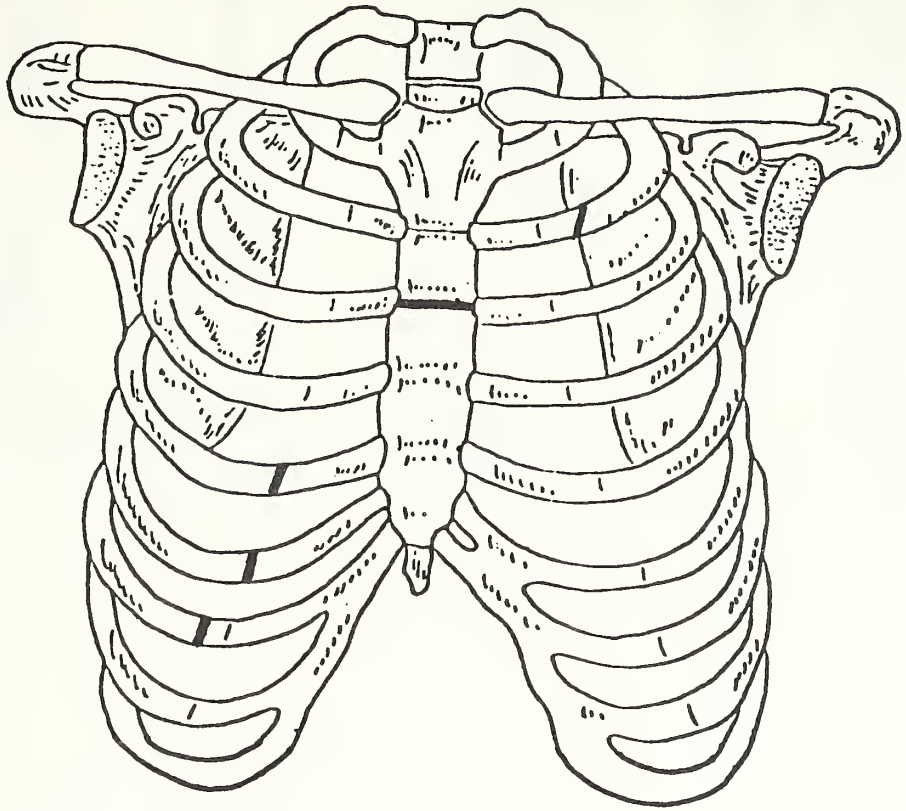
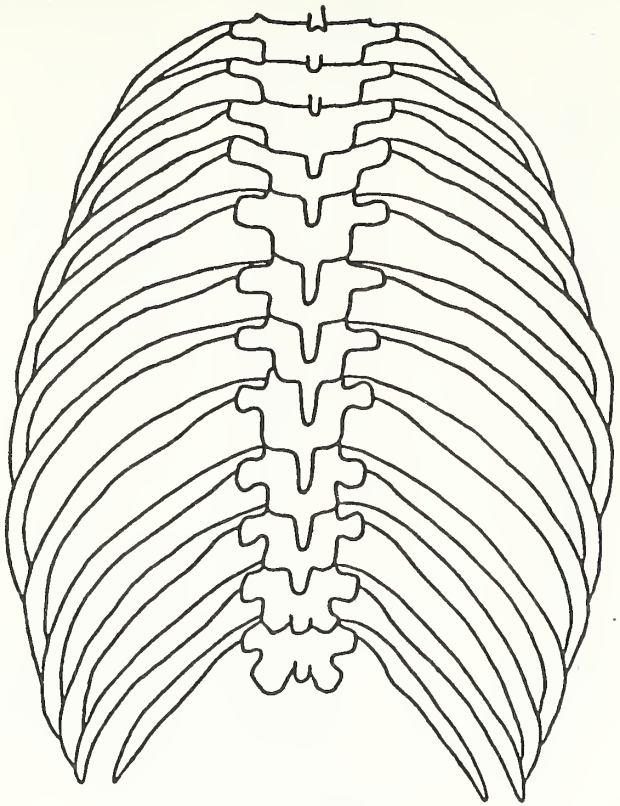
Run No. H 80 06 DOT





Number of rib fractures 4

Run No. H 80 008

a) Subject:
Male, 19 years, body weight 66 kg, body length 180 cm (further anthropometric data s. incl.) cause of death: drugs

b) Testconditions:
Frontal collision, impact velocity 49,3 km/h, Volvo-Puls, medium sled deceleration 14,5 g (evaluated from the collision velocity and the stopping distance).

c) Instrumentation:
9-accelerometer head, 11-accelerometer thorax, 3-accelerometer pelvis, lung pressure, lap-belt force

d) Medical findings:

Body surface:	Skin abrasions over the left upper arm bone head and the hip bones.
Head:	No injuries
Thorax:	Fractures of the 6th and 7th rib left
Abdomen:	No injuries
Vertebral column:	Hemorrhages in all muscle layers of C5 to Th3. Hemorrhages in the medium and upper muscle layers between occiput and C2, right. Hemorrhages into the deep muscle layer between occiput and C1.
Extremities:	No injuries

e) Severity degree:
AIS-Thorax 3, AIS-Abdomen 1, AIS-Vertebral Column 2, MAIS - 3

BENDING TESTS

Run No.H80008

	max. Force (N)	max. Deflexion (mm)	Cross Section (mm^2)
6th rib	213	6,0	31
7th rib	206	6,0	33

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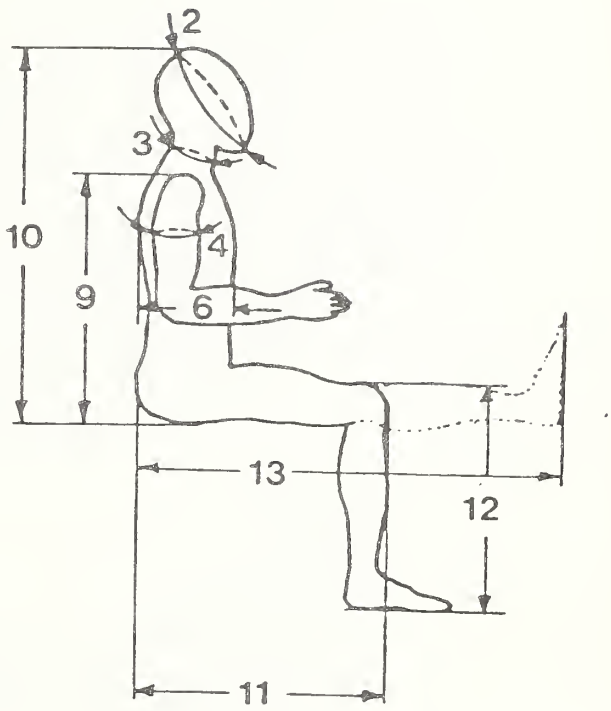
Run No. H 8o oo8

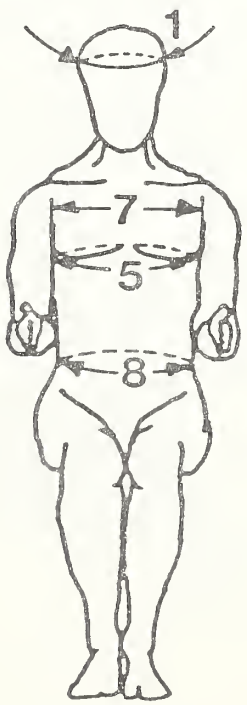
Anthropometrical Data

Body weight ....66 kg

Body length ....18o cm

1. Hat dimension .....56.....cm
2. Head circumference.....66.....cm
3. Neck circumfer. .....36.....cm
4. Upper arm circumfer. .....28.....cm
5. Chest circumfer. .....87.....cm
6. Chest height .....22.....cm
7. Chest width .....3o.....cm
8. Abdomen circumfer. .....89.....cm
9. Buttocks - shoulder .....68.....cm
10. Seat height .....93.....cm
11. Pelvis - knee .....58.....cm
12. Sole of foot - knee .....55.....cm
13. Pelvis - heal .....1oo.....cm





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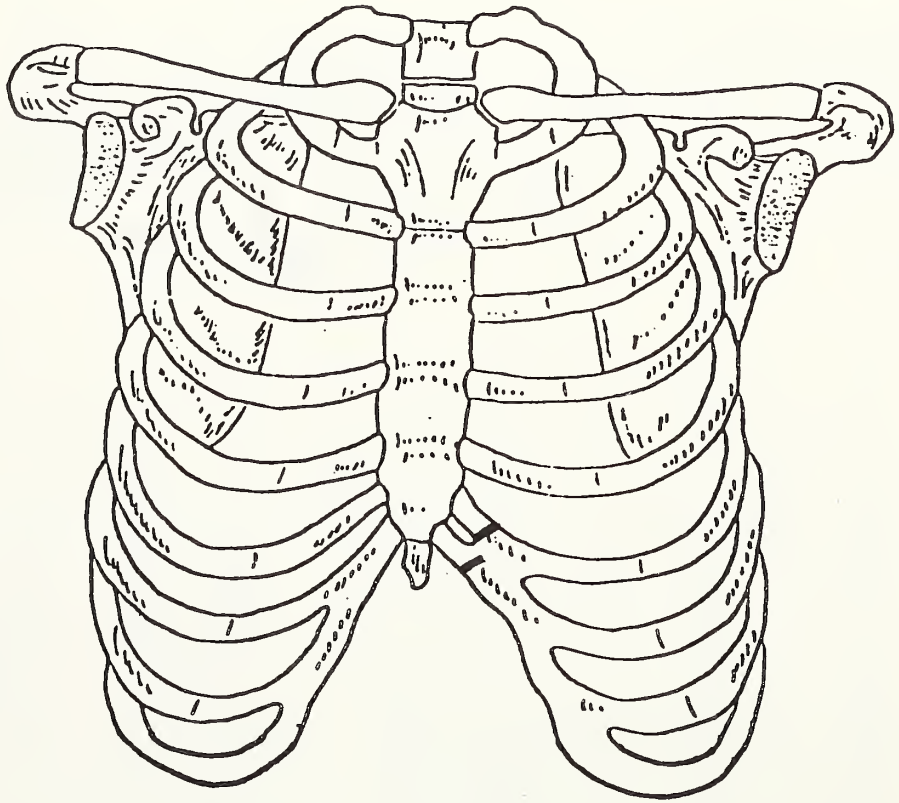
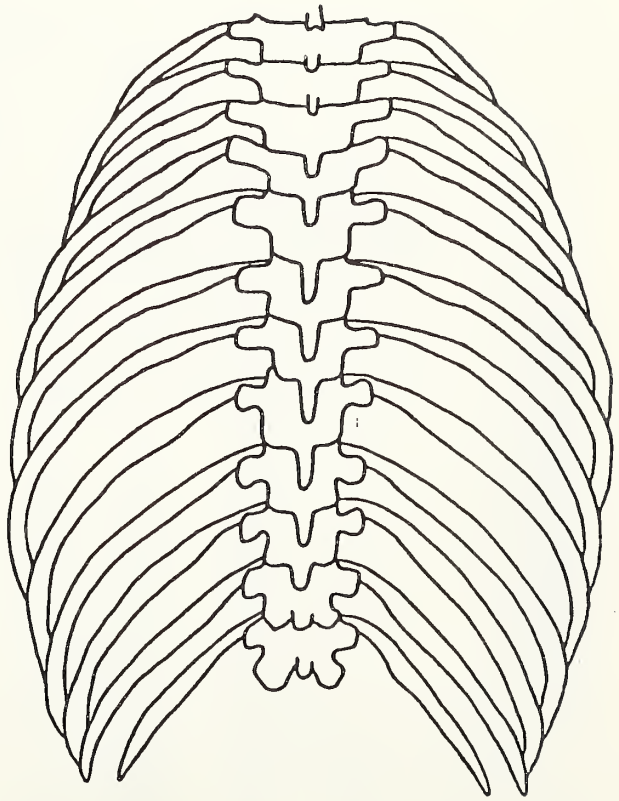
H 80 08 DOT
Run No. .....





Number of rib fractures ..2...

APPENDIX IX

LATERAL IMPACT HSRI SID

INTO A RIGID WALL
IMPACT VELOCITY :
24 KM/H 32 KM/H

INTO A WALL WITH ARR PAD.
IMPACT VELOCITY :
24 KM/H 32 KM/H

INTO A WALL WITH 6'',12'' ENSOLITE PAD.
IMPACT VELOCITY :
27 KM/H 32 KM/H

INTO A RIGID WALL WITH 1'',2'',3'' ENSOLITE LEFT ARM SIMULATION
IMPACT VELOCITY :
24 KM/H, 28 KM/H, 32 KM/H

Run No. H 81 01D

a) Subject:
HSRI side impact dummy.

b) Test conditions:
Lateral collision - rigid wall - impact velocity 23,2km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis.

Run No. H 81 02D

a) Subject:
HSRI side impact dummy.

b) Test conditions:
Lateral collision - rigid wall - impact velocity 23,6 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis.

Run No. H 81 03D

a) Subject:
HSRI side impact dummy.

b) Test conditions:
Lateral collision - APR padding - impact velocity 23,8 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis.

Run No. H 81 04D

a) Subject:
HSRI side impact dummy.

b) Test conditions:
Lateral collision - APR padding - impact velocity 23,8 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis.

Run No. H 81 05D

a) Subject:
HSRI side impact dummy.

b) Test conditions:
Lateral collision - rigid wall - impact velocity 32,3 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis.

Run No. H 81 06D

a) Subject:
HSRI side impact dummy.

b) Test conditions:
Lateral collision - rigid wall - impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis.

Run No. H8301D

a) Subject:
Side impact dummy.

b) Test conditions:
Lateral collision, 6" US padding (ensolite), impact velocity 27 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces, pelvis forces.

Run No. H8302D

a) Subject:
Side impact dummy.

b) Test Conditions:
Lateral collision, 6" US padding (ensolite), impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces, pelvis forces.

Run No. H8303D

a) Subject:
Side impact dummy.

b) Test Conditions:
Lateral collision, 12" US padding (ensolite), impact velocity 32 km/h.

c) Instrumentation:
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces, pelvis forces.

Run No. H834D

a) Subject
Side impact dummy.

b) Test conditions
Lateral impact, rigid wall, impact velocity 24 km/h.

c) Instrumentation
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces, pelvis forces.

Run No. H835D

a) Subject
Side impact dummy.

b) Test conditions
Lateral impact, APR-padding, impact velocity 32 km/h.

c) Instrumentation
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces, pelvis forces.

Run No. H836D

a) Subject
Side impact dummy.

b) Test conditions
Lateral impact, rigid wall, impact velocity 32 km/h.

c) Instrumentation
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces, pelvis forces.

a) Subject
In all tests, the side impact dummy (SID) has been used.

b) Instrumentation
Sled deceleration, 9-accelerometer head, 12-accelerometer thorax, 3-accelerometer pelvis, shoulder forces (for all tests), for the tests H843D, H844D, H835D also thorax deformation.

Run No. H841D

Test Conditions
lateral impact, 3 x 1" Ensolite as left arm simulation, impact velocity 29 km/h.

Run No. H 842D

Test Conditions
lateral impact, 2 x 1" Ensolite as left arm simulation, impact velocity 32 km/h.

Run No. H843D

Test Conditions
lateral impact, 2 x 1" Ensolite as left arm simulation, impact velocity 23 km/h.

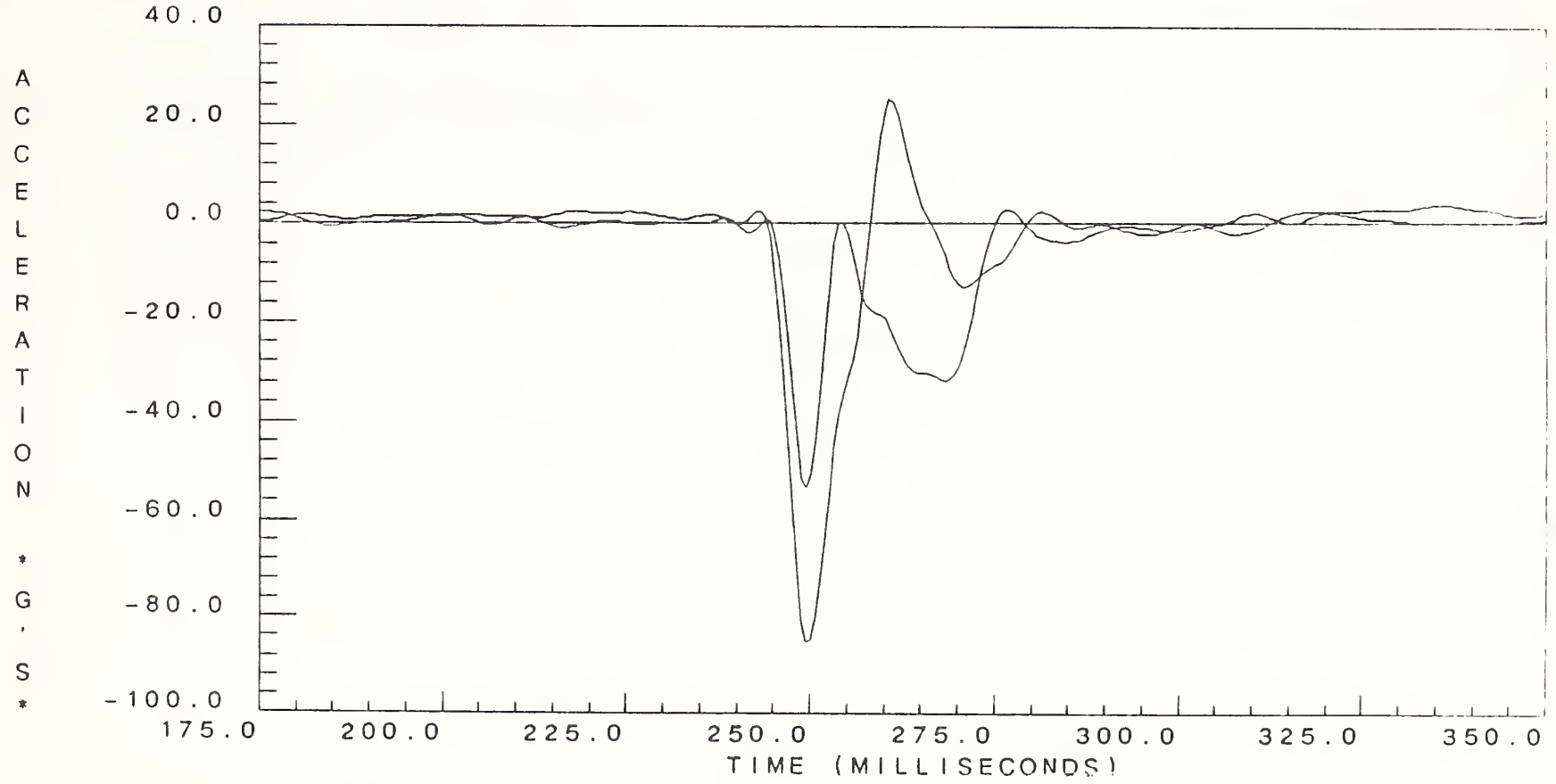
Run No. H844D

Test Conditions
lateral impact, 1" Ensolite and the standard padding as left arm simulation, impact velocity 32 km/h.

Run No. H845D
Test Conditions
lateral impact, standard padding as left arm simulation, impact velocity 32 km/h.

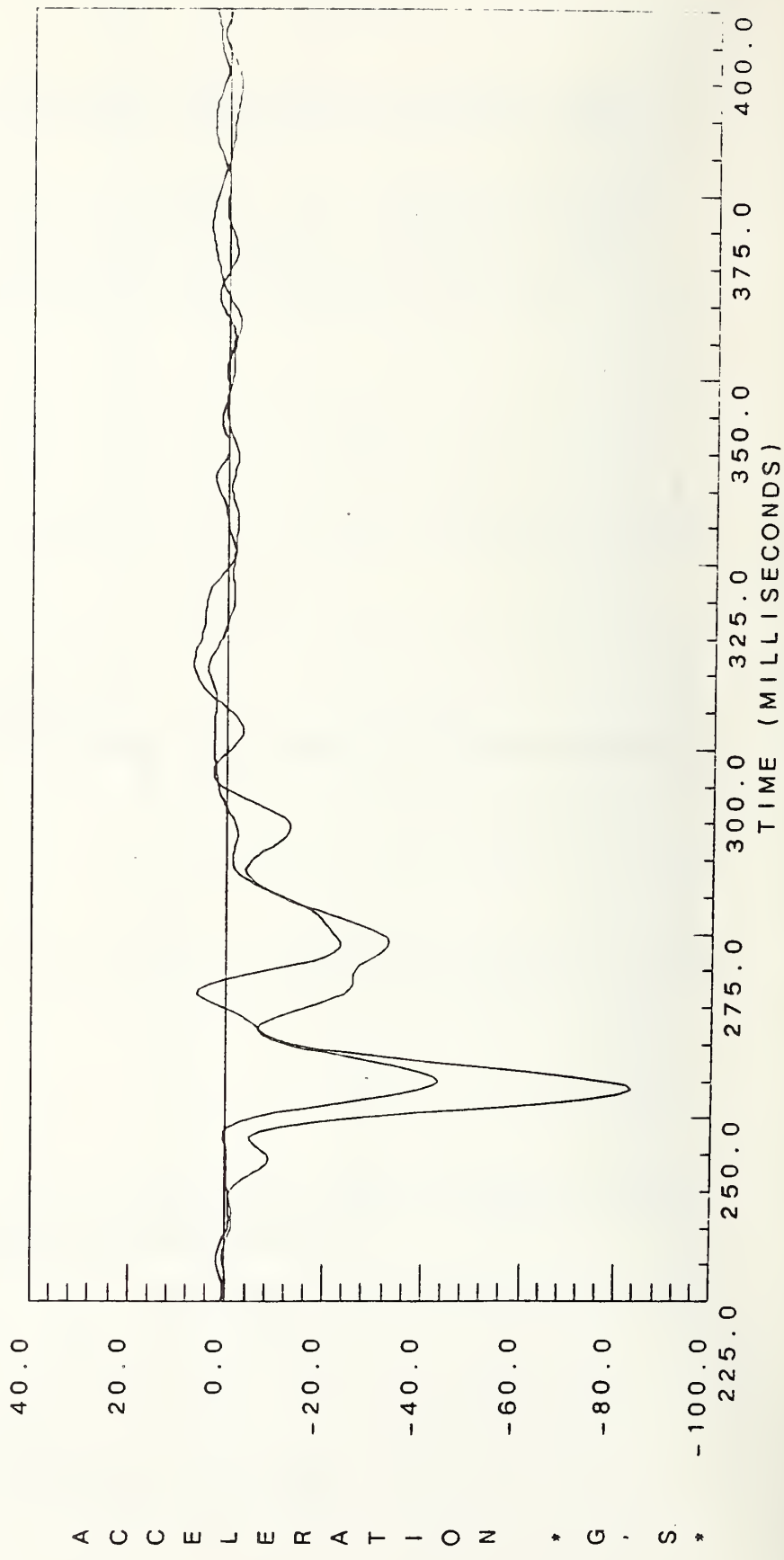
Side Impact

15 MPH APR Padding, Upper Rib (Y)



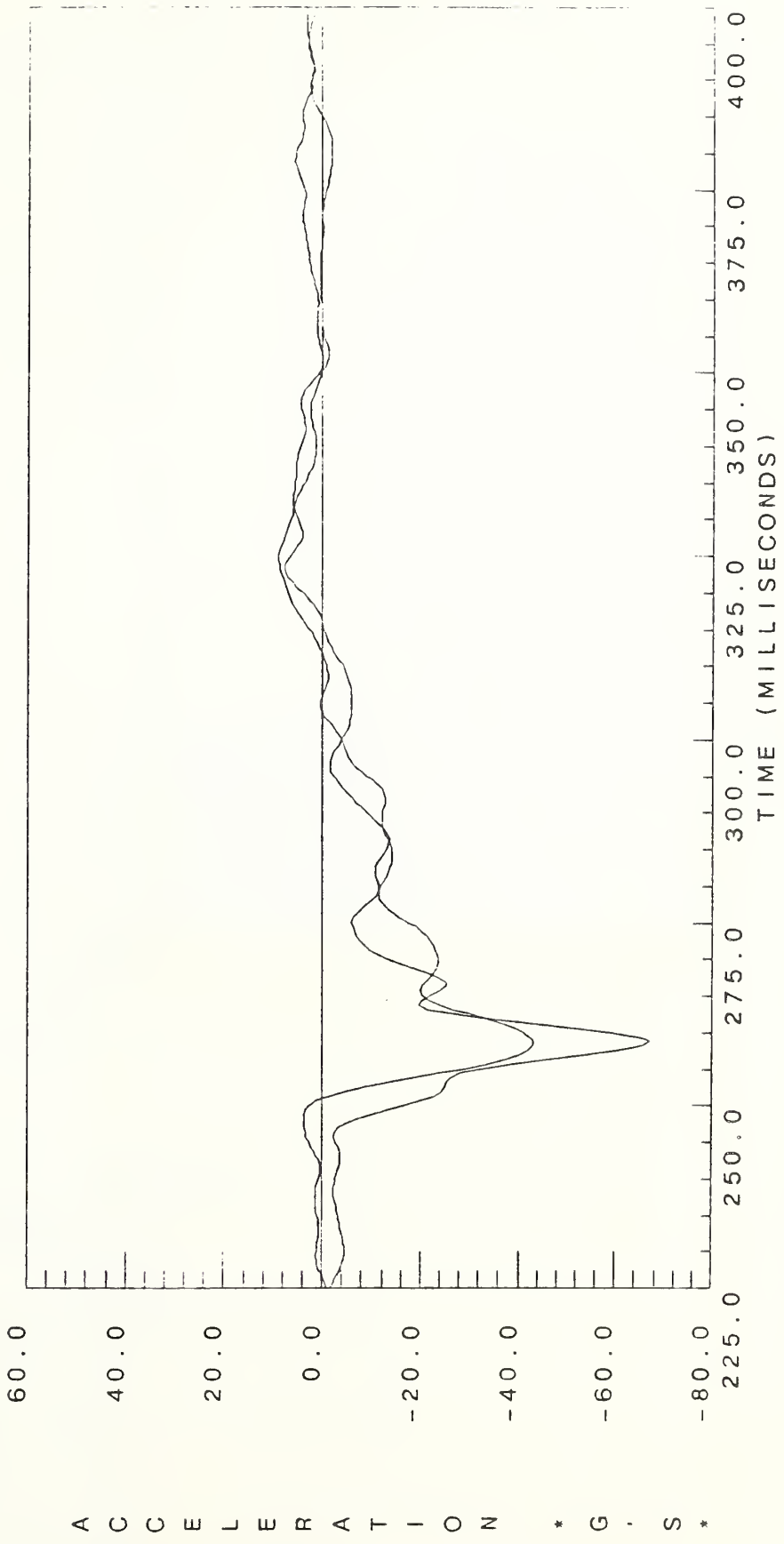
Side Impact

15 MPH APR Padding, Upper Spine (Y)



Side Impact

15 MPH APR Padding, Lower Spine (Y)



Side Impact

15 MPH APR Padding, Pelvis (Y)